R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers	
Total Number of Particles Counted:	**1035**
Total Number of Fragments	**885.5**
Average Aspect Ratio for All Particles Counted:	24 :1
Average Aspect Ratio for "Cleavage Fragments":	22 :1
All Particles Counted ≤1 μ in Diameter:	825
Percentage of All Particles Counted ≤1 μ in Diameter	80%
Number of "Cleavage Fragments" ≤1 μ in diameter	719
Percentage of "Cleavage Fragments" ≤1 μ in diameter	69%
All Particles Counted- Aspect Ratios ≥10:1	868
Percentage of all Particles Counted- Aspect Ratios ≥10:1	84%
Number of "Cleavage Fragments" ≥10:1 in Aspect Ratio	752
Percentage of "Cleavage Fragments" ≥10:1 in Aspect Ratio	73%

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
Moving Boxes (3/6/02)	A011036	CLEAV	0.5	6.20	0.40	16 :1	0	
		CLEAV	1	9.10	0.80	11 :1		
Moving Boxes (3/6/02)	A011037	CLEAV	0.5	25.00	0.70	36 :1	0	
		CLEAV	0.5	17.50	0.90	19 :1		
Moving Boxes (3/6/02)	A011046	CLEAV	0.5	9.00	1.00	9 :1	0.001	
		CLEAV	1	11.50	1.00	12 :1		
Moving Boxes & Small Area Clearance(3/6/02)	A011066	CLEAV	1	22.50	0.85	26 :1	0	
Moving Boxes & Small Area Clearance(3/6/02)	A011068	CLEAV	0.5	11.50	0.30	38 :1	0	
		CLEAV	1	10.50	1.20	9 :1		
		CLEAV	1	10.50	0.50	21 :1		
		CLEAV	1	13.50	0.60	23 :1		
		CLEAV	0.5	17.00	1.25	14 :1		
		CLEAV	0.5	65.00	0.80	81 :1		
Moving Boxes & Small Area Clearance(3/6/02)	A011069	CLEAV	0.5	7.50	0.50	15 :1	0.002	0.01
		CLEAV	1	7.50	0.40	19 :1		
		CLEAV	1	10.00	0.70	14 :1		
		CLEAV	0.5	11.00	0.70	16 :1		
		ASBFRM	1	26.00	0.65	40 :1		
		CLEAV	0.5	8.50	0.50	17 :1		
		CLEAV	0.5	16.00	0.50	32 :1		
Moving Boxes & Small Area Clearance(3/6/02)	A011074	ASBFRM	1	52.50	1.00	53 :1	0.01	0.025
		CLEAV	1	13.70	1.25	11 :1		
		CLEAV	0.5	11.60	0.80	15 :1		
Moving Boxes & Small Area Clearance(3/6/02)	A011077	CLEAV	1	8.00	1.00	8 :1	0	2

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
Moving Boxes & Small Area Clearance(3/6/02)	A011080	ASBFRM	0.5	30.00	0.30	100 :1	0.36	1.02
		CLEAV	1	5.20	0.50	10 :1		
		ASBFRM	1	5.50	0.60	9 :1		
		ASBFRM	1	17.00	0.30	57 :1		
		CLEAV	1	30.00	1.20	25 :1		
		CLEAV	1	40.00	0.50	80 :1		
		CLEAV	1	11.00	0.40	28 :1		
		CLEAV	0.5	8.00	0.70	11 :1		
		CLEAV	1	60.00	1.00	60 :1		
		ASBFRM	1	7.00	0.30	23 :1		
		CLEAV	1	32.00	0.90	36 :1		
		CLEAV	1	7.00	0.75	9 :1		
		ASBFRM	0.5	29.00	1.00	29 :1		
		CLEAV	1	16.50	1.00	17 :1		
		ASBFRM	1	13.00	0.30	43 :1		
		CLEAV	1	5.50	0.50	11 :1		
		CLEAV	0.5	7.00	0.60	12 :1		
		CLEAV	1	10.50	0.50	21 :1		
		CLEAV	0.5	59.00	1.00	59 :1		
		ASBFRM	1	12.00	1.90	6 :1		
		CLEAV	0.5	13.00	1.20	11 :1		
		ASBFRM	1	12.00	0.90	13 :1		
		ASBFRM	0.5	8.00	4.00	2 :1		
		ASBFRM	1	7.50	0.90	8 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		CLEAV	1	11.00	1.50	7 :1		
		CLEAV	1	23.00	1.00	23 :1		
		CLEAV	1	13.00	1.00	13 :1		
		CLEAV	1	8.00	0.30	27 :1		
		ASBFRM	1	15.00	0.60	25 :1		
Moving Boxes & Small Area Clearance(3/6/02)	A011081	CLEAV	1	38.00	2.25	17 :1	0.244	1.2
		TREM ASBFRM	1	22.50	0.50	45 :1		
		TREM ASBFRM	1	15.00	0.55	27 :1		
		CLEAV	1	12.50	0.70	18 :1		
		CLEAV	0.5	35.00	2.50	14 :1		
		CLEAV	0.5	30.00	0.55	55 :1		
		CLEAV	1	8.00	0.30	27 :1		
		CLEAV	1	6.50	0.60	11 :1		
		CLEAV	1	5.25	0.90	6 :1		
		CLEAV	1	38.00	0.60	63 :1		
		ASBFRM	1	25.00	0.50	50 :1		
		CLEAV	1	10.00	0.65	15 :1		
		CLEAV	1	29.00	1.25	23 :1		
		ASBFRM	0.5	25.00	0.50	50 :1		
		CLEAV	1	5.75	0.50	12 :1		
		CLEAV	1	15.00	2.75	5 :1		
		CLEAV	1	11.50	0.55	21 :1		
		ASBFRM	1	84.00	0.80	105 :1		
		CLEAV	1	7.50	0.50	15 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		CLEAV	1	14.75	0.50	30 :1		
		CLEAV	1	22.50	0.40	56 :1		
		ASBFRM	1	10.50	0.30	35 :1		
		CLEAV	1	7.50	0.60	13 :1		
		CLEAV	1	7.50	0.50	15 :1		
		CLEAV	0.5	45.00	2.50	18 :1		
		CLEAV	1	19.00	1.50	13 :1		
		CLEAV	1	8.00	0.90	9 :1		
		CLEAV	1	7.00	2.00	4 :1		
		CLEAV	1	5.75	1.00	6 :1		
AM Background (3/7/02)	A011094	CLEAV	1	7.00	0.75	9 :1	0.001	
Fan Installation (3/7/02)	A011103	CLEAV	1	10.50	1.50	7 :1	0	
Fan Installation (3/7/02)	A011104	CLEAV	0.5	10.00	0.80	13 :1	0	
		CLEAV	0.5	10.00	0.50	20 :1		
		CLEAV	0.5	7.00	1.50	5 :1		
		CLEAV	1	60.00	0.50	120 :1		
		CLEAV	0.5	6.50	0.80	8 :1		
		CLEAV	1	7.50	0.50	15 :1		
		CLEAV	0.5	58.00	1.00	58 :1		
		CLEAV	0.5	15.00	0.35	43 :1		
		CLEAV	0.5	10.00	1.50	7 :1		
		CLEAV	1	32.00	1.00	32 :1		
		CLEAV	0.5	23.00	0.80	29 :1		
Fan Installation (3/7/02)	A011105	CLEAV	1	9.50	0.55	17 :1	0	

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		CLEAV	1	11.50	1.20	10 :1		
		CLEAV	1	12.50	0.35	36 :1		
		CLEAV	0.5	6.50	0.85	8 :1		
		CLEAV	1	6.50	0.50	13 :1		
		CLEAV	1	7.50	0.30	25 :1		
		CLEAV	1	11.00	0.55	20 :1		
		CLEAV	1	16.00	0.65	25 :1		
		CLEAV	1	7.50	0.85	9 :1		
		CLEAV	1	6.50	0.60	11 :1		
		CLEAV	1	6.50	0.35	19 :1		
		CLEAV	0.5	5.50	0.30	18 :1		
		CLEAV	1	19.50	0.75	26 :1		
		CLEAV	1	17.00	2.50	7 :1		
		CLEAV	0.5	18.50	0.70	26 :1		
		CLEAV	0.5	19.50	1.50	13 :1		
		CLEAV	1	10.00	0.65	15 :1		
		CLEAV	0.5	10.00	0.80	13 :1		
		CLEAV	0.5	9.00	1.30	7 :1		
Fan Installation (3/7/02)	A011106	CLEAV	1	10.20	0.80	13 :1	0	
Fan Installation (3/7/02)	A011107	CLEAV	0.5	12.00	1.00	12 :1	0	
Fan Installation (3/7/02)	A011116	CLEAV	0.5	20.00	2.50	8 :1	0.127	1.59
		CLEAV	1	6.00	0.50	12 :1		
		CLEAV	1	9.75	0.50	20 :1		
		CLEAV	0.5	22.50	0.55	41 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		CLEAV	1	26.00	0.50	52 :1		
		CLEAV	1	29.50	0.45	66 :1		
		CLEAV	1	10.00	0.80	13 :1		
		CLEAV	0.5	30.00	2.50	12 :1		
		CLEAV	1	8.00	0.50	16 :1		
		CLEAV	1	10.50	1.25	8 :1		
		CLEAV	1	7.00	1.50	5 :1		
		CLEAV	1	10.00	1.00	10 :1		
		CLEAV	1	8.00	0.50	16 :1		
		CLEAV	1	7.50	0.30	25 :1		
		CLEAV	1	11.50	1.25	9 :1		
		CLEAV	0.5	49.50	1.00	50 :1		
		CLEAV	1	9.50	1.00	10 :1		
		CLEAV	1	6.00	0.60	10 :1		
		CLEAV	1	24.50	2.00	12 :1		
		CLEAV	1	7.00	0.30	23 :1		
		CLEAV	1	15.00	0.75	20 :1		
		CLEAV	1	7.00	0.80	9 :1		
		CLEAV	1	8.00	0.50	16 :1		
		ASBFRM	1	28.00	1.50	19 :1		
		CLEAV	1	25.50	1.20	21 :1		
		CLEAV	1	6.00	0.30	20 :1		
		CLEAV	1	16.00	0.30	53 :1		
		ASBFRM	0.5	27.50	1.00	28 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		CLEAV	1	8.50	0.50	17 :1		
		CLEAV	1	13.00	0.50	26 :1		
		ASBFRM	0.5	32.00	1.60	20 :1		
		CLEAV	1	11.00	1.00	11 :1		
		CLEAV	1	9.50	0.50	19 :1		
		CLEAV	1	8.00	0.30	27 :1		
		CLEAV	1	6.00	0.80	8 :1		
		CLEAV	1	5.50	0.30	18 :1		
		CLEAV	1	17.00	0.75	23 :1		
		CLEAV	0.5	13.00	0.50	26 :1		
		ASBFRM	1	12.00	0.30	40 :1		
		CLEAV	1	15.00	0.50	30 :1		
		CLEAV	1	9.50	0.40	24 :1		
Fan Installation (3/7/02)	A011117	CLEAV	1	25.00	0.80	31 :1	0	
		CLEAV	1	28.00	0.80	35 :1		
		CLEAV	1	10.00	1.00	10 :1		
		CLEAV	0.5	35.00	0.80	44 :1		
		CLEAV	1	22.50	1.20	19 :1		
		CLEAV	0.5	42.50	1.50	28 :1		
		CLEAV	1	7.00	0.40	18 :1		
		CLEAV	1	19.00	3.00	6 :1		
		CLEAV	1	5.50	0.50	11 :1		
		CLEAV	1	8.50	0.70	12 :1		
		CLEAV	1	5.50	0.50	11 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		CLEAV	1	8.50	0.50	17 :1		
		CLEAV	0.5	21.00	1.50	14 :1		
		CLEAV	0.5	22.00	0.80	28 :1		
		CLEAV	1	25.00	2.20	11 :1		
		CLEAV	0.5	20.00	0.50	40 :1		
		CLEAV	0.5	25.00	1.00	25 :1		
		CLEAV	1	40.00	0.50	80 :1		
		CLEAV	1	22.00	1.20	18 :1		
		CLEAV	1	5.20	0.50	10 :1		
		CLEAV	0.5	26.00	3.00	9 :1		
		CLEAV	0.5	24.00	1.50	16 :1		
		CLEAV	1	21.00	0.80	26 :1		
		CLEAV	1	20.00	0.80	25 :1		
		CLEAV	1	8.58	0.80	11 :1		
		CLEAV	1	8.00	0.80	10 :1		
		CLEAV	0.5	22.00	1.20	18 :1		
		CLEAV	1	21.00	3.50	6 :1		
		CLEAV	1	7.00	0.50	14 :1		
		CLEAV	0.5	12.50	1.20	10 :1		
		CLEAV	1	7.20	0.50	14 :1		
		CLEAV	0.5	10.50	0.50	21 :1		
		CLEAV	0.5	19.00	2.50	8 :1		
		CLEAV	0.5	13.50	0.90	15 :1		
		CLEAV	0.5	30.00	1.20	25 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		CLEAV	1	10.00	0.40	25 :1		
		CLEAV	0.5	10.00	1.00	10 :1		
		CLEAV	0.5	9.00	1.50	6 :1		
		CLEAV	0.5	14.00	1.00	14 :1		
		CLEAV	0.5	11.00	0.50	22 :1		
Fan Installation (3/7/02)	A011118	ASBFRM	1	12.50	0.40	31 :1	0.032	
		ASBFRM	0.5	45.00	1.50	30 :1		
Fan Installation (3/7/02)	A011121	CLEAV	1	11.75	1.75	7 :1	0	
Fan Installation (3/7/02)	A011124	CLEAV	1	31.00	0.70	44 :1	0.326	1.91
		CLEAV	1	8.50	0.30	28 :1		
		CLEAV	1	14.00	0.70	20 :1		
		CLEAV	1	8.00	0.30	27 :1		
		ASBFRM	1	22.00	0.30	73 :1		
		CLEAV	1	7.50	0.40	19 :1		
		ASBFRM	1	9.00	0.30	30 :1		
		CLEAV	0.5	9.50	0.50	19 :1		
		ASBFRM	1	34.50	0.40	86 :1		
		CLEAV	0.5	7.50	0.50	15 :1		
		CLEAV	1	10.25	0.30	34 :1		
		CLEAV	1	10.50	1.50	7 :1		
		CLEAV	1	5.70	0.50	11 :1		
		CLEAV	1	34.00	0.60	57 :1		
		CLEAV	1	8.00	0.50	16 :1		
		ASBFRM	0.5	50.50	0.40	126 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		CLEAV	1	5.10	1.00	5 :1		
		CLEAVE	0.5	13.00	2.00	7 :1		
		CLEAV	1	12.00	0.50	24 :1		
		CLEAV	1	6.25	0.50	13 :1		
		CLEAV	1	5.75	0.50	12 :1		
		CLEAV	0.5	10.50	0.60	18 :1		
		CLEAV	1	21.50	0.70	31 :1		
Fan Installation (3/7/02)	A011125	CLEAV	1	7.00	0.40	18 :1	0.07	0.74
		CLEAV	1	6.00	1.00	6 :1		
		CLEAV	1	7.50	1.00	8 :1		
		CLEAV	1	16.50	0.90	18 :1		
		ASBFRM	1	12.00	0.50	24 :1		
		CLEAV	0.5	16.00	1.00	16 :1		
		CLEAV	1	9.00	0.60	15 :1		
		CLEAV	1	11.25	1.00	11 :1		
		CLEAV	1	11.50	0.30	38 :1		
		CLEAV	1	6.50	0.40	16		
		CLEAV	1	18.50	0.60	31		
Fan Installation (3/7/02)	A011128	CLEAV	0.5	20.00	0.80	25 :1	0	
Fan Installation (3/7/02)	A011129	CLEAV	1	35.00	1.00	35 :1	0	
Fan Installation (3/7/02)	A011130	ASBFRM	1	10.50	0.40	26 :1	0.01	
Post Installation (3/7/02)	A011139	CLEAV	1	15.00	5.00	3 :1	0	
Moving Boxes (3/12/02)	A011172	TREM ASBFRM	1	13.50	0.50	27 :1	0.002	
Moving Boxes (3/12/02)	A011173	TREM ASBFRM	0.5	25.00	0.85	29 :1	0.001	

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
Moving Boxes (3/12/02)	A011176	TREM CLEAV	0.5	13.00	0.90	14 :1		
		TREM CLEAV	0.5	13.00	1.00	13 :1	0	
		TREM CLEAV	1	32.00	0.60	53 :1		
		TREM CLEAV	1	21.00	1.00	21 :1		
		TREM CLEAV	0.5	15.00	0.30	50 :1		
		TREM CLEAV	0.5	11.50	0.40	29 :1		
		TREM CLEAV	1	12.50	0.50	25 :1		
		RICH CLEAV	1	17.50	1.00	18 :1		
		TREM CLEAV	1	10.00	0.30	33 :1		
Moving Boxes (3/12/02)	A011177	RICH ASBFRM	0.5	22.50	0.65	35 :1	0.01	
PM Background (3/12/02)	A011189	RICH CLEAV	1	19.00	0.40	48 :1	0.001	
Small Area Removal (3/12/02)	A011205	TREM CLEAV	1	15.00	0.90	17 :1	0	
		TREM CLEAV	1	25.00	1.50	17 :1		
		TREM CLEAV	1	12.50	1.00	13 :1		
		TREM CLEAV	1	7.50	0.60	13 :1		
		TREM CLEAV	0.5	11.50	1.20	10 :1		
		TREM CLEAV	1	11.50	0.40	29 :1		
		TREM CLEAV	1	13.50	2.00	7 :1		
		TREM CLEAV	1	24.50	1.50	16 :1		
		TREM CLEAV	0.5	6.50	0.50	13 :1		
		TREM CLEAV	1	5.50	0.50	11 :1		
		TREM CLEAV	1	10.00	0.50	20 :1	0	
		TREM CLEAV	1	13.50	0.30	45 :1		
Small Area Removal (3/12/02)	A011206	TREM CLEAV	0.5	10.20	0.70	15 :1	0	

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
Small Area Removal (3/12/02)	A011209	RICH CLEAV	0.5	20.00	0.60	33 :1	0	
		TREM CLEAV	0.5	10.00	1.40	7 :1		
		RICH CLEAV	1	15.40	0.30	51 :1		
		RICH CLEAV	1	7.50	0.80	9 :1		
		RICH CLEAV	1	22.50	1.00	23 :1		
		RICH CLEAV	1	8.50	1.50	6 :1		
		TREM CLEAV	1	8.00	0.80	10 :1		
		TREM CLEAV	1	12.50	1.20	10 :1		
		TREM CLEAV	0.5	50.00	2.50	20 :1		
		TREM CLEAV	1	11.50	1.50	8 :1		
		ACT CLEAV	1	8.00	0.50	16 :1		
		TREM CLEAV	0.5	40.00	2.40	17 :1		
		TREM CLEAV	1	9.00	0.30	30 :1		
		TREM CLEAV	0.5	10.50	1.20	9 :1		
		TREM CLEAV	.5	17.50	1.80	10 :1		
		TREM CLEAV	0.5	10.00	1.50	7 :1		
		RICH CLEAV	0.5	15.30	0.50	31 :1		
Small Area Removal (3/12/02)	A011210	TREM CLEAV	1	7.50	1.75	4 :1	0.161	1.22
		TREM CLEAV	1	11.00	1.00	11 :1	0.161	
		TREM ASBFRM	1	25.00	0.35	71 :1		
		TREM ASBFRM	0.5	8.10	0.35	23 :1		
		TREM CLEAV	0.5	10.75	1.15	9 :1		
		TREM CLEAV	1	22.75	0.50	46 :1		
		RICH CLEAV	1	35.00	1.00	35 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	0.5	39.00	1.80	22 :1		
		TREM ASBFRM	0.5	15.00	0.50	30 :1		
		TREM CLEAV	1	12.50	1.30	10 :1		
		RICH CLEAV	1	6.00	0.75	8 :1		
		RICH CLEAV	1	6.50	0.40	16 :1		
		RICH CLEAV	1	31.00	1.00	31 :1		
		RICH CLEAV	1	9.90	0.45	22 :1		
		RICH ASBFRM	0.5	30.00	0.50	60 :1		
		TREM CLEAV	1	70.00	1.00	70 :1		
		TREM CLEAV	1	15.00	1.00	15 :1		
		RICH CLEAV	1	13.50	0.70	19 :1		
		TREM CLEAV	1	6.25	0.50	13 :1		
		TREM CLEAV	1	6.50	0.50	13 :1		
		TREM CLEAV	0.5	8.00	1.25	6 :1		
		TREM CLEAV	1	7.25	0.55	13 :1		
		RICH CLEAV	1	10.00	0.35	29 :1		
		RICH CLEAV	0.5	70.00	1.00	70 :1		
		TREM CLEAV	1	70.00	2.00	35 :1		
		TREM CLEAV	1	34.00	1.00	34 :1		
		TREM CLEAV	1	9.00	1.00	9 :1		
		RICH ASBFRM	1	21.00	0.80	26 :1		
		TREM CLEAV	1	7.00	0.50	14 :1		
		TREM CLEAV	0.5	32.50	2.50	13 :1		
		RICH CLEAV	0.5	75.25	0.90	84 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	7.00	1.00	7 :1		
		TREM CLEAV	1	30.00	1.00	30 :1		
		RICH CLEAV	1	16.00	1.00	16 :1		
		TREM CLEAV	1	25.00	1.25	20 :1		
		TREM CLEAV	0.5	11.50	0.50	23 :1		
		RICH CLEAV	1	11.50	0.80	14 :1		
		TREM ASBFRM	1	9.25	0.45	21 :1		
		TREM CLEAV	1	20.50	0.80	26 :1		
Small Area Removal (3/12/02)	A011211	TREM CLEAV	0.5	11.50	3.00	4 :1	0.174	0.59
		RICH CLEAV	1	5.75	0.40	14 :1		
		TREM CLEAV	0.5	10.00	1.20	8 :1		
		TREM CLEAV	1	17.35	0.50	35 :1		
		TREM CLEAV	0.5	52.50	1.00	53 :1		
		TREM CLEAV	1	5.50	0.45	12 :1		
		TREM ASBFRM	1	11.00	0.50	22 :1		
		TREM ASBFRM	1	5.40	0.65	8 :1		
		ACT CLEAV	1	6.50	0.50	13 :1		
		TREM CLEAV	1	8.00	0.75	11 :1		
		TREM ASBFRM	1	25.00	1.50	17 :1		
		TREM CLEAV	1	5.25	0.70	8 :1		
		TREM CLEAV	1	8.00	0.40	20 :1		
		ACT CLEAV	1	7.50	0.50	15 :1		
		TREM ASBFRM	1	31.00	1.75	18 :1		
Small Area Removal (3/12/02)	A011212	RICH ASBFRM	1	36.00	1.00	36 :1	0.034	0.08

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		RICH CLEAV	1	21.75	0.80	27 :1		
		TREM CLEAV	1	10.25	0.45	23 :1		
		RICH ASBFRM	0.5	6.00	0.50	12 :1		
		TREM ASBFRM	1	26.00	0.50	52 :1		
		RICH ASBFRM	1	25.00	1.00	25 :1		
		RICH CLEAV	1	7.45	0.55	14 :1		
		RICH CLEAV	1	7.50	2.00	4 :1		
		TREM CLEAV	1	10.50	1.25	8 :1		
AM Background (3/13/02)	A011224	TREM ASBFRM	1	22.00	0.60	37 :1	0.001	
AM Large Area Removal (3/13/02)	A011238	RICH CLEAV	1	7.10	0.50	14 :1	0.034	0.18
		RICH ASBFRM	1	18.50	0.45	41 :1		
		TREM ASBFRM	1	22.50	0.50	45 :1		
		TREM CLEAV	0.5	16.00	1.80	9 :1		
		TREM CLEAV	1	9.00	0.80	11 :1		
		TREM CLEAV	1	7.20	0.50	14 :1		
		TREM CLEAV	0.5	7.50	0.50	15 :1		
		TREM CLEAV	1	9.00	0.45	20 :1		
		TREM CLEAV	1	7.00	0.40	18 :1		
		TREM CLEAV	0.5	7.00	0.75	9 :1		
		RICH CLEAV	1	7.50	0.50	15 :1		
		RICH CLEAV	1	9.00	0.50	18 :1		
		TREM ASBFRM	1	18.00	1.10	16 :1		
		RICH ASBFRM	1	9.50	0.35	27 :1		
		TREM CLEAV	1	8.50	0.55	15 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		TREM ASBFRM	0.5	22.00	0.60	37 :1		
		TREM CLEAV	1	6.25	0.50	13 :1		
		TREM ASBFRM	1	13.50	0.45	30 :1		
		RICH CLEAV	0.5	51.00	0.75	68 :1		
		RICH CLEAV	1	12.00	0.40	30 :1		
		RICH CLEAV	1	6.00	0.30	20 :1		
		TREM CLEAV	0.5	6.50	0.50	13 :1		
		RICH ASBFRM	0.5	55.00	0.50	110 :1		
		RICH CLEAV	0.5	10.00	1.90	5 :1		
		TREM CLEAV	1	20.00	1.10	18 :1		
		TREM CLEAV	1	9.75	1.10	9 :1		
		TREM CLEAV	0.5	5.20	0.45	12 :1		
		TREM CLEAV	1	10.20	0.75	14 :1		
		TREM CLEAV	1	13.50	0.45	30 :1		
		RICH CLEAV	1	5.80	0.30	19 :1		
		TREM CLEAV	1	22.50	0.65	35 :1		
		TREM CLEAV	1	7.50	0.70	11 :1		
		TREM CLEAV	1	10.30	0.50	21 :1		
		RICH CLEAV	0.5	7.50	0.60	13 :1		
		TREM CLEAV	1	12.30	0.90	14 :1		
		RICH CLEAV	1	10.60	0.40	27 :1		
		TREM CLEAV	1	5.50	0.50	11 :1		
		TREM ASBFRM	1	22.25	0.45	49 :1		
		TREM ASBFRM	1	22.50	0.60	38 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	0.5	20.00	0.50	40 :1		
		RICH CLEAV	0.5	10.00	0.70	14 :1		
		RICH CLEAV	1	11.00	0.55	20 :1		
		RICH CLEAV	1	9.00	0.65	14 :1		
		RICH CLEAV	1	19.00	0.50	38 :1		
		TREM CLEAV	1	5.50	1.00	6 :1		
		TREM CLEAV	0.5	5.50	0.40	14 :1		
		TREM CLEAV	0.5	9.00	0.90	10 :1		
		RICH ASBFRM	1	14.50	0.50	29 :1		
		RICH CLEAV	1	26.00	0.50	52 :1		
		TREM CLEAV	1	7.00	0.30	23 :1		
		TREM CLEAV	0.5	9.25	1.00	9 :1		
		TREM CLEAV	0.5	34.00	0.90	38 :1		
		TREM CLEAV	1	34.00	1.00	34 :1		
		TREM CLEAV	1	9.50	2.00	5 :1		
		TREM CLEAV	1	9.00	0.30	30 :1		
		TREM CLEAV	1	12.00	0.30	40 :1		
		TREM CLEAV		27.25	3.50	8 :1		
		TREM CLEAV	1	10.00	2.50	4 :1		
		TREM ASBFRM	1	12.50	0.40	31 :1		
		TREM CLEAV	0.5	7.25	1.25	6 :1		
		TREM CLEAV	1	7.25	0.50	15 :1		
		TREM CLEAV	1	8.00	0.50	16 :1		
		TREM ASBFRM	1	8.20	0.30	27 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		TREM CLEAV	1	8.00	0.90	9 :1		
		RICH CLEAV	1	7.20	0.45	16 :1		
		TREM CLEAV	1	15.25	0.95	16 :1		
		RICH ASBFRM	0.5	22.50	0.50	45 :1		
		TREM CLEAV	1	6.50	0.40	16 :1		
		TREM CLEAV	1	12.00	0.50	24 :1		
		TREM CLEAV	1	13.00	1.20	11 :1		
		TREM CLEAV	1	14.00	1.10	13 :1		
AM Large Area Removal (3/13/02)	A011239	RICH CLEAV	0.5	16.50	0.50	33 :1	0.016	0.13
		RICH ASBFRM	0.5	36.00	0.30	120 :1		
		TREM CLEAV	1	5.50	0.30	18 :1		
		TREM CLEAV	1	14.50	1.50	10 :1		
		RICH CLEAV	1	7.50	0.35	21 :1		
		RICH CLEAV	0.5	12.50	1.25	10 :1		
		TREM CLEAV	1	7.00	0.50	14 :1		
		TREM CLEAV	0.5	12.50	0.80	16 :1		
		TREM CLEAV	0.5	12.00	0.50	24 :1		
		TREM CLEAV	1	12.75	1.10	12 :1		
		TREM CLEAV	1	8.50	0.35	24 :1		
		TREM CLEAV	1	22.50	2.00	11 :1		
		RICH CLEAV	0.5	83.00	1.00	83 :1		
		TREM CLEAV	1	10.00	1.60	6 :1		
		TREM CLEAV	1	6.50	0.50	13 :1		
		TREM CLEAV	0.5	27.50	0.55	50 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		RICH ASBFRM	0.5	18.00	0.50	36 :1		
		RICH CLEAV	0.5	35.00	1.00	35 :1		
		TREM CLEAV	1	30.00	1.00	30 :1		
		TREM CLEAV	1	15.00	0.65	23 :1		
		RICH CLEAV	1	6.20	1.15	5 :1		
		RICH CLEAV	1	67.50	1.00	68 :1		
		RICH ASBFRM	0.5	37.50	0.80	47 :1		
		RICH CLEAV	1	19.00	2.00	10 :1		
		TREM ASBFRM	0.5	51.00	0.50	102 :1		
		TREM CLEAV	1	8.00	0.50	16 :1		
		RICH CLEAV	1	9.50	0.40	24 :1		
		TREM CLEAV	1	10.00	0.40	25 :1		
		RICH CLEAV	1	21.50	0.35	61 :1		
		RICH CLEAV	0.5	35.00	1.00	35 :1		
		TREM CLEAV	0.5	42.50	1.75	24 :1		
		TREM CLEAV	0.5	11.00	2.00	6 :1		
		RICH CLEAV	0.5	15.00	1.00	15 :1		
		TREM ASBFRM	0.5	28.00	0.35	80 :1		
		RICH CLEAV	0.5	6.50	0.85	8 :1		
		RICH CLEAV	1	5.25	0.50	11 :1		
		RICH CLEAV	1	12.50	1.20	10 :1		
		TREM CLEAV	1	10.25	0.65	16 :1		
		RICH CLEAV	1	12.25	0.35	35 :1		
		RICH CLEAV	0.5	55.00	0.30	183 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	1	14.00	0.75	19 :1		
		RICH CLEAV	1	23.00	0.40	58 :1		
		TREM CLEAV	1	5.50	0.50	11 :1		
		TREM CLEAV	1	56.00	0.35	160 :1		
		TREM CLEAV	0.5	8.00	0.65	12 :1		
		TREM CLEAV	1	12.50	0.40	31 :1		
		RICH CLEAV	1	10.00	0.65	15 :1		
		RICH CLEAV	1	6.50	0.35	19 :1		
		RICH CLEAV	1	7.75	0.50	16 :1		
		RICH CLEAV	1	38.50	0.75	51 :1		
		RICH ASBFRM	0.5	26.50	2.00	13 :1		
		RICH ASBFRM	0.5	23.50	0.80	29 :1		
		TREM CLEAV	1	11.00	0.75	15 :1		
		TREM ASBFRM	1	7.50	0.30	25 :1		
		RICH CLEAV	0.5	8.50	1.15	7 :1		
		RICH CLEAV	0.5	9.25	0.60	15 :1		
		RICH CLEAV	1	14.85	0.85	17 :1		
		RICH ASBFRM	1	20.00	0.50	40 :1		
		TREM CLEAV	0.5	25.00	0.35	71 :1		
		RICH CLEAV	1	10.00	0.30	33 :1		
		TREM CLEAV	1	35.00	0.50	70 :1		
		RICH CLEAV	1	10.00	2.00	5 :1		
		RICH CLEAV	0.5	17.50	0.45	39 :1		
		TREM CLEAV	1	15.00	2.50	6 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH ASBFRM	0.5	8.00	0.50	16 :1		
		TREM CLEAV	0.5	40.00	1.50	27 :1		
		TREM CLEAV	1	5.10	0.40	13 :1		
		RICH CLEAV	0.5	20.00	0.80	25 :1		
		TREM CLEAV	0.5	5.25	1.10	5 :1		
		TREM ASBFRM	0.5	24.00	1.10	22 :1		
		RICH CLEAV	1	6.50	0.65	10 :1		
		RICH CLEAV	0.5	37.50	0.35	107 :1		
		RICH CLEAV	0.5	14.00	1.85	8 :1		
		TREM CLEAV	1	18.00	0.45	40 :1		
		TREM CLEAV	1	36.50	1.25	29 :1		
AM Large Area Removal (3/13/02)	A011242	TREM CLEAV	0.5	32.50	0.60	54 :1	0.302	1.84
		RICH CLEAV	1	31.50	0.75	42 :1		
		TREM CLEAV	0.5	15.00	2.35	6 :1		
		RICH CLEAV	0.5	8.50	0.35	24 :1		
		RICH CLEAV	1	5.15	0.40	13 :1		
		RICH ASBFRM	1	8.00	0.35	23 :1		
		RICH CLEAV	0.5	51.75	0.90	58 :1		
		TREM CLEAV	1	32.75	2.50	13 :1		
		TREM ASBFRM	1	7.85	0.35	22 :1		
		RICH CLEAV	0.5	25.00	6.00	4 :1		
		RICH CLEAV	1	9.00	0.50	18 :1		
		TREM CLEAV	1	14.00	0.40	35 :1		
		RICH CLEAV	0.5	14.00	0.75	19 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM ASBFRM	1	11.50	0.45	26 :1		
		RICH CLEAV	1	45.00	0.80	56 :1		
		TREM ASBFRM	0.5	25.00	1.50	17 :1		
		RICH ASBFRM	1	21.50	0.50	43 :1		
		TREM CLEAV	0.5	41.75	0.40	104 :1		
		TREM CLEAV	1	42.50	2.50	17 :1		
		RICH CLEAV	1	10.50	0.65	16 :1		
		TREM CLEAV	0.5	28.25	0.35	81 :1		
		TREM CLEAV	1	30.00	2.50	12 :1		
		RICH CLEAV	1	17.60	0.65	27 :1		
		TREM CLEAV	1	7.25	0.35	21 :1		
		TREM CLEAV	1	11.65	0.90	13 :1		
		TREM CLEAV	0.5	21.75	0.60	36 :1		
		TREM CLEAV	1	9.50	0.30	32 :1		
		TREM CLEAV	1	22.50	0.30	75 :1		
		TREM CLEAV	0.5	9.25	0.80	12 :1		
		RICH CLEAV	1	12.15	0.75	16 :1		
		RICH CLEAV	1	6.00	0.50	12 :1		
		TREM CLEAV	1	6.50	0.50	13 :1		
		RICH CLEAV	1	11.50	0.30	38 :1		
		TREM CLEAV	0.5	9.25	1.10	8 :1		
		RICH CLEAV	1	6.00	0.30	20 :1		
		RICH CLEAV	1	6.00	0.50	12 :1		
		RICH CLEAV	1	12.50	0.60	21 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		TREM CLEAV	1	13.50	0.45	30 :1		
		RICH CLEAV	0.5	5.50	0.35	16 :1		
		TREM ASBFRM	0.5	21.00	0.30	70 :1		
		RICH CLEAV	0.5	12.75	0.65	20 :1		
		TREM CLEAV	1	11.00	0.75	15 :1		
		TREM ASBFRM	1	99.50	1.10	90 :1		
		TREM CLEAV	1	7.50	0.35	21 :1		
		TREM ASBFRM	1	30.00	0.50	60 :1		
		TREM CLEAV	1	11.50	1.25	9 :1		
		TREM CLEAV	0.5	23.00	0.35	66 :1		
		TREM CLEAV	1	17.50	0.30	58 :1		
		RICH CLEAV	1	15.00	0.35	43 :1		
		TREM CLEAV	0.5	22.50	1.25	18 :1		
		RICH CLEAV	1	14.50	0.50	29 :1		
		TREM CLEAV	1	11.50	1.00	12 :1		
AM Large Area Removal (3/13/02)	A011243	RICH ASBFRM	0.5	17.50	2.50	7 :1	0.291	3.46
		TREM ASBFRM	0.5	18.50	1.00	19 :1		
		RICH CLEAV	1	12.50	0.40	31 :1		
		TREM CLEAV	1	5.10	0.50	10 :1		
		RICH CLEAV	1	33.50	15.10	2 :1		
		RICH CLEAV	1	52.50	1.25	42 :1		
		RICH CLEAV	1	14.00	0.75	19 :1		
		RICH CLEAV	0.5	46.00	0.75	61 :1		
		TREM CLEAV	0.5	42.50	0.75	57 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	1	23.25	0.75	31 :1		
		RICH CLEAV	1	7.50	0.80	9 :1		
		RICH CLEAV	0.5	25.00	1.25	20 :1		
		TREM CLEAV	1	9.10	0.75	12 :1		
		TREM CLEAV	0.5	10.00	0.60	17 :1		
		RICH CLEAV	0.5	5.50	0.65	8 :1		
		TREM CLEAV	1	24.00	1.00	24 :1		
		TREM CLEAV	1	51.50	1.75	29 :1		
		TREM CLEAV	1	14.00	0.65	22 :1		
		TREM CLEAV	1	8.50	0.90	9 :1		
		RICH CLEAV	1	10.00	0.85	12 :1		
		RICH CLEAV	1	6.25	0.75	8 :1		
		TREM ASBFRM	1	17.00	0.55	31 :1		
		RICH CLEAV	1	5.15	0.50	10 :1		
		TREM CLEAV	1	15.00	0.40	38 :1		
		TREM CLEAV	1	19.00	1.50	13 :1		
		TREM CLEAV	1	21.50	1.00	22 :1		
		RICH CLEAV	1	46.75	0.40	117 :1		
		RICH CLEAV	1	5.50	0.45	12 :1		
		RICH CLEAV	1	6.75	0.35	19 :1		
		TREM CLEAV	1	7.25	0.65	11 :1		
		RICH CLEAV	1	5.85	0.90	7 :1		
		TREM CLEAV	1	12.00	0.30	40 :1		
		RICH CLEAV	1	17.00	1.50	11 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	8.50	0.85	10 :1		
		TREM CLEAV	1	5.50	0.30	18 :1		
		TREM CLEAV	1	5.85	1.20	5 :1		
		RICH ASBFRM	0.5	11.50	0.65	18 :1		
		TREM CLEAV	1	27.50	1.10	25 :1		
		TREM CLEAV	1	10.00	0.75	13 :1		
		TREM CLEAV	0.5	39.00	1.00	39 :1		
		TREM CLEAV	1	5.50	0.30	18 :1		
		TREM CLEAV	1	7.50	0.40	19 :1		
		TREM CLEAV	0.5	11.00	2.00	6 :1		
		TREM ASBFRM	1	13.00	0.65	20 :1		
		TREM CLEAV	0.5	7.25	0.75	10 :1		
		TREM CLEAV	1	11.00	1.00	11 :1		
		TREM CLEAV	1	10.50	0.40	26 :1		
		RICH CLEAV	1	9.50	1.00	10 :1		
		TREM CLEAV	1	10.00	0.65	15 :1		
		RICH CLEAV	1	11.00	0.30	37 :1		
		TREM CLEAV	0.5	8.50	0.75	11 :1		
		TREM ASBFRM	1	7.00	0.50	14 :1		
		TREM CLEAV	1	12.00	1.00	12 :1		
		RICH CLEAV	1	10.00	0.60	17 :1		
		TREM CLEAV	1	5.25	1.00	5 :1		
		TREM CLEAV	0.5	5.25	0.50	11 :1		
		TREM CLEAV	1	9.50	1.00	10 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	11.00	1.00	11 :1		
		TREM CLEAV	1	7.25	0.50	15 :1		
		TREM CLEAV	1	13.50	1.00	14 :1		
AM Large Area Removal (3/13/02)	A011244	TREM CLEAV	1	6.80	0.40	17 :1	0.02	0.52
		RICH CLEAV	0.5	10.00	0.80	13 :1		
		TREM CLEAV	1	5.75	0.35	16 :1		
		TREM CLEAV	1	12.25	0.50	25 :1		
		TREM CLEAV	0.5	5.50	0.50	11 :1		
		TREM CLEAV	1	7.30	0.60	12 :1		
		TREM CLEAV	1	12.50	2.10	6 :1		
		TREM CLEAV	0.5	13.50	2.40	6 :1		
		TREM CLEAV	1	11.80	0.50	24 :1		
		TREM CLEAV	0.5	6.00	0.40	15 :1		
		RICH CLEAV	1	9.00	1.10	8 :1		
		TREM CLEAV	0.5	39.00	2.60	15 :1		
		TREM CLEAV	0.5	5.20	0.35	15 :1		
		RICH CLEAV	1	7.50	0.50	15 :1		
		TREM CLEAV	1	13.00	0.75	17 :1		
		TREM ASBFRM	0.5	31.50	0.55	57 :1		
		TREM CLEAV	1	10.50	0.55	19 :1		
		TREM CLEAV	1	7.50	0.50	15 :1		
		TREM CLEAV	0.5	10.00	2.60	4 :1		
		TREM CLEAV	1	26.50	1.60	17 :1		
		RICH CLEAV	1	7.50	0.65	12 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		TREM CLEAV	1	9.00	2.00	5 :1		
		TREM ASBFRM	0.5	36.00	1.20	30 :1		
		TREM CLEAV	1	20.00	2.00	10 :1		
		TREM CLEAV	1	7.00	0.50	14 :1		
		TREM CLEAV	0.5	38.00	1.00	38 :1		
		TREM CLEAV	1	11.00	0.40	28 :1		
		TREM CLEAV	1	6.00	0.60	10 :1		
		TREM CLEAV	1	6.00	0.40	15 :1		
		RICH CLEAV	1	10.00	0.70	14 :1		
		TREM CLEAV	1	6.25	1.20	5 :1		
		TREM CLEAV	1	7.00	0.50	14 :1		
		TREM CLEAV	1	11.00	0.30	37 :1		
		TREM CLEAV	1	12.00	1.00	12 :1		
		TREM CLEAV	1	12.50	0.65	19 :1		
		TREAM CLEAV	1	6.25	0.50	13 :1		
		RICH CLEAV	0.5	12.00	0.70	17 :1		
		TREM CLEAV	0.5	10.50	0.50	21 :1		
		TREM CLEAV	1	8.50	0.45	19 :1		
		TREM ASBFRM	0.5	88.50	0.90	98 :1		
		TREM CLEAV	0.5	12.00	0.80	15 :1		
		TREM CLEAV	1	7.50	0.35	21 :1		
		TREM CLEAV	1	5.50	0.50	11 :1		
		TREM CLEAV	1	9.00	1.00	9 :1		
		TREM CLEAV	1	6.25	0.50	13 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		TREM CLEAV	1	8.50	1.00	9 :1		
AM Large Area Removal (3/13/02)	A011245	RICH ASBFRM	1	22.50	1.15	20 :1	0.07	0.63
		RICH CLEAV	1	8.00	0.35	23 :1		
		RICH CLEAV	1	7.35	0.70	11 :1		
		RICH CLEAV	0.5	22.50	0.85	26 :1		
		TREM CLEAV	1	27.50	1.75	16 :1		
		TREM CLEAV	1	15.00	2.50	6 :1		
		TREM CLEAV	0.5	67.50	5.00	14 :1		
		RICH CLEAV	0.5	61.50	1.25	49 :1		
		RICH CLEAV	1	23.25	1.50	16 :1		
		RICH ASBFRM	1	9.00	0.40	23 :1		
		TREM CLEAV	0.5	16.50	0.50	33 :1		
		RICH CLEAV	0.5	14.75	1.50	10 :1		
		RICH CLEAV	1	9.75	0.75	13 :1		
		RICH CLEAV	1	5.15	0.35	15 :1		
		TREM CLEAV	0.5	32.50	0.85	38 :1		
		TREM CLEAV	0.5	22.50	1.10	20 :1		
		TREM CLEAV	0.5	8.00	1.60	5 :1		
		TREM CLEAV	0.5	37.00	1.60	23 :1		
		RICH CLEAV	1	7.00	0.30	23 :1		
		TREM CLEAV	1	8.00	0.80	10 :1		
		RICH ASBFRM	1	10.00	0.30	33 :1		
		RICH CLEAV	1	56.00	0.80	70 :1		
		RICH ASBFRM	0.5	22.00	0.45	49 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	0.5	29.50	1.60	18 :1		
		TREM CLEAV	0.5	8.30	0.30	28 :1		
		RICH CLEAV	0.5	26.00	0.45	58 :1		
		TREM CLEAV	1	75.00	0.50	150 :1		
		RICH CLEAV	1	21.00	0.55	38 :1		
		TREM CLEAV	1	14.80	0.80	19 :1		
		TREM CLEAV	1	17.50	0.30	58 :1		
		RICH CLEAV	1	8.00	0.65	12 :1		
		TREM CLEAV	0.5	30.00	0.50	60 :1		
		RICH CLEAV	1	24.00	0.60	40 :1		
		RICH CLEAV	1	17.50	0.50	35 :1		
		TREM CLEAV	0.5	13.50	0.35	39 :1		
		TREM ASBFRM	1	26.00	0.60	43 :1		
		RICH CLEAV	1	7.00	0.40	18 :1		
		RICH CLEAV	1	7.50	0.40	19 :1		
		RICH CLEAV	1	12.00	0.35	34 :1		
		RICH CLEAV	0.5	22.50	0.65	35 :1		
		TREM CLEAV	1	10.25	0.55	19 :1		
		TREM CLEAV	0.5	7.50	1.25	6 :1		
		RICH CLEAV	1	7.45	0.30	25 :1		
		RICH CLEAV	1	25.00	1.25	20 :1		
		TREM CLEAV	1	12.50	1.25	10 :1		
		RICH CLEAV	1	8.50	0.30	28 :1		
		TREM CLEAV	1	9.75	0.30	33 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		RICH CLEAV	1	5.50	1.00	6 :1		
		RICH CLEAV	1	25.00	0.30	83 :1		
AM Large Area Removal (3/13/02)	A011248	TREM CLEAV	0.5	9.00	1.00	9 :1	0.463	2.26
		TREM ASBFRM	1	35.00	0.65	54 :1		
		TREM ASBFRM	1	26.00	0.90	29 :1		
		CLEAV	1	12.50	1.20	10 :1		
		CLEAV	1	4.90	4.50	1 :1		
		RICH CLEAV	0.5	8.50	0.55	15 :1		
		TREM CLEAV	1	8.50	0.90	9 :1		
		TREM CLEAV	0.5	40.00	2.50	16 :1		
		TREM CLEAV	1	14.50	0.65	22 :1		
		TREM CLEAV	1	12.50	0.60	21 :1		
		TREM ASBFRM	1	18.50	0.80	23 :1		
		RICH CLEAV	1	20.00	0.50	40 :1		
		TREM CLEAV	1	10.00	0.75	13 :1		
		TREM CLEAV	1	6.25	1.25	5 :1		
		TREM CLEAV	0.5	60.00	1.00	60 :1		
		TREM CLEAV	1	6.00	0.50	12 :1		
		TREM CLEAV	1	7.50	0.65	12 :1		
		TREM CLEAV	1	15.50	0.50	31 :1		
		RICH CLEAV	1	5.50	0.50	11 :1		
		TREM CLEAV	1	22.50	0.60	38 :1		
		RICH CLEAV	1	18.00	0.30	60 :1		
		TREM CLEAV	0.5	12.75	0.35	36 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl/Clea v)
		TREM ASBFRM	1	10.15	0.55	18 :1		
		TREM ASBFRM	1	9.00	0.50	18 :1		
		TREM CLEAV	0.5	18.50	0.90	21 :1		
		RICH ASBFRM	1	13.25	0.50	27 :1		
		TREM CLEAV	0.5	10.00	0.70	14 :1		
		TREM CLEAV	1	43.00	1.75	25 :1		
		RICH CLEAV	0.5	7.00	0.50	14 :1		
		TREM CLEAV	1	9.00	0.50	18 :1		
		TREM ASBFRM	0.5	12.50	0.30	42 :1		
		TREM CLEAV	0.5	70.00	3.00	23 :1		
		RICH CLEAV	1	9.00	0.40	23 :1		
		TREM CLEAV	1	13.00	0.75	17 :1		
		TREM CLEAV	1	14.00	0.50	28 :1		
		TREM CLEAV	0.5	9.00	0.50	18 :1		
		TREM CLEAV	1	12.50	0.70	18 :1		
		TREM CLEAV	0.5	12.10	0.50	24 :1		
		RICH CLEAV	0.5	6.00	1.50	4 :1		
		TREM CLEAV	1	35.00	0.45	78 :1		
		TREM CLEAV	1	8.00	0.50	16 :1		
		TREM CLEAV	0.5	6.00	0.45	13 :1		
		RICH CLEAV	1	5.30	0.35	15 :1		
		TREM CLEAV	1	5.40	0.40	14 :1		
		RICH CLEAV	0.5	15.00	1.10	14 :1		
		TREM CLEAV	1	5.20	0.45	12 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		TREM CLEAV	1	8.75	1.20	7 :1		
		RICH CLEAV	1	7.00	0.75	9 :1		
		TREM CLEAV	0.5	13.50	0.40	34 :1		
		TREM CLEAV	1	21.00	0.80	26 :1		
		TREM CLEAV	1	7.25	0.80	9 :1		
		TREM CLEAV	0.5	8.00	0.50	16 :1		
		TREM ASBFRM	0.5	60.00	1.25	48 :1		
		TREM CLEAV	1	19.00	1.00	19 :1		
		TREM ASBFRM	1	22.00	0.40	55 :1		
AM Large Area Removal (3/13/02)	A011249	TREM CLEAV	0.5	11.00	1.00	11 :1	0.356	2.95
		TREM CLEAV	0.5	47.00	1.00	47 :1		
		TREM CLEAV	1	16.00	0.50	32 :1		
		RICH CLEAV	1	7.25	1.00	7 :1		
		TREM CLEAV	1	33.50	1.50	22 :1		
		TREM CLEAV	1	5.50	0.90	6 :1		
		TREM CLEAV	1	10.25	0.30	34 :1		
		TREM CLEAV	1	11.50	1.00	12 :1		
		TREM CLEAV	1	7.50	0.50	15 :1		
		TREM ASBFRM	1	16.00	0.30	53 :1		
		RICH ASBFRM	1	12.50	0.55	23 :1		
		TREM CLEAV	1	18.50	1.00	19 :1		
		RICH CLEAV	1	30.00	2.00	15 :1		
		RICH ASBFRM	1	14.50	0.60	24 :1		
		TREM CLEAV	0.5	20.25	0.30	68 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	1	19.50	0.55	35 :1		
		RICH CLEAV	1	14.50	1.30	11 :1		
		TREM CLEAV	0.5	51.50	3.00	17 :1		
		TREM CLEAV	0.5	73.50	2.00	37 :1		
		TREM CLEAV	0.5	20.00	1.00	20 :1		
		TREM CLEAV	1	6.00	0.30	20 :1		
		RICH CLEAV	0.5	20.00	0.60	33 :1		
		TREM CLEAV	0.5	41.00	2.25	18 :1		
		TREM CLEAV	0.5	5.20	0.60	9 :1		
		TREM CLEAV	0.5	5.30	0.50	11 :1		
		TREM CLEAV	1	13.75	0.70	20 :1		
		TREM CLEAV	1	12.75	0.35	36 :1		
		TREM ASBFRM	1	39.00	0.60	65 :1		
		RICH CLEAV	1	12.50	0.70	18 :1		
		TREM CLEAV	0.5	10.00	0.50	20 :1		
		RICH CLEAV	1	10.50	0.45	23 :1		
		TREM CLEAV	1	10.00	0.50	20 :1		
		TREM CLEAV	1	14.25	0.40	36 :1		
		TREM CLEAV	1	7.00	0.60	12 :1		
		RICH CLEAV	1	5.50	0.55	10 :1		
		TREM CLEAV	1	6.80	0.50	14 :1		
		TREM CLEAV	0.5	5.50	0.50	11 :1		
		TREM CLEAV	0.5	19.25	0.50	39 :1		
		TREM CLEAV	1	6.00	0.35	17 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	7.50	0.50	15 :1		
		TREM ASBFRM	1	17.50	0.40	44 :1		
		TREM CLEAV	1	12.75	0.45	28 :1		
		RICH ASBFRM	1	13.00	0.70	19 :1		
		TREM CLEAV	1	9.50	0.50	19 :1		
		TREM CLEAV	1	10.10	1.00	10 :1		
		TREM CLEAV	1	14.50	0.45	32 :1		
		TREM CLEAV	1	11.25	0.35	32 :1		
		RICH CLEAV	1	7.50	0.45	17 :1		
		RICH ASBFRM	1	14.00	0.40	35 :1		
		TREM CLEAV	0.5	15.00	0.75	20 :1		
		RICH CLEAV	0.5	21.00	2.75	8 :1		
		TREM CLEAV	1	16.80	0.80	21 :1		
		TREM CLEAV	1	28.50	1.10	26 :1		
		TREM CLEAV	1	9.50	0.50	19 :1		
		TREM CLEAV	1	6.00	0.40	15 :1		
		TREM CLEAV	1	9.00	0.55	16 :1		
		TREM CLEAV	1	5.80	0.50	12 :1		
		TREM CLEAV	1	6.50	0.50	13 :1		
		RICH CLEAV	1	5.20	0.50	10 :1		
		TREM CLEAV	0.5	19.50	0.50	39 :1		
		RICH CLEAV	1	5.50	0.40	14 :1		
		TREM CLEAV	1	17.00	1.20	14 :1		
		TREM CLEAV	1	7.50	0.30	25 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	1	8.00	0.40	20 :1		
		RICH CLEAV	1	10.50	0.60	18 :1		
		RICH CLEAV	0.5	14.00	1.25	11 :1		
		RICH CLEAV	0.5	20.50	1.00	21 :1		
		TREM CLEAV	1	19.50	1.00	20 :1		
		RICH CLEAV	0.5	12.00	0.90	13 :1		
		TREM CLEAV	1	6.00	0.50	12 :1		
		TREM CLEAV	1	31.00	0.50	62 :1		
		TREM CLEAV	1	16.00	1.00	16 :1		
		TREM CLEAV	1	10.00	1.30	8 :1		
		RICH CLEAV	0.5	15.00	0.80	19 :1		
		RICH CLEAV	1	6.00	0.40	15 :1		
		TREM CLEAV	1	5.25	0.35	15 :1		
		TREM CLEAV	1	13.00	0.45	29 :1		
		TREM CLEAV	1	9.00	0.90	10 :1		
		TREM ASBFRM	1	18.50	0.50	37 :1		
		TREM CLEAV	1	14.50	0.60	24 :1		
		TREM CLEAV	1	15.00	0.30	50 :1		
		RICH CLEAV	1	12.00	0.30	40 :1		
		TREM CLEAV	1	15.00	2.00	8 :1		
		TREM ASBFRM	1	48.00	2.00	24 :1		
		TREM CLEAV	1	6.00	0.60	10 :1		
PM Background (3/13/02)	A011261	TREM CLEAV	1	7.00	0.60	12 :1	0	
		RICH CLEAV	1	10.50	0.60	18 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
PM Large Area Removal (3/13/02)	A011275	TREM CLEAV	1	6.50	1.00	7 :1	0.002	
		TREM CLEAV	1	7.00	0.40	18 :1		
		RICH ASBFRM	1	6.50	1.00	7 :1		
PM Large Area Removal (3/13/02)	A011276	TREM CLEAV	1	26.00	29.00	1 :1	0	
PM Large Area Removal (3/13/02)	A011277	TREM CLEAV	1	15.00	2.00	8 :1	0	
		TREM CLEAV	1	17.50	0.75	23 :1		
		TREM CLEAV	0.5	16.50	1.00	17 :1		
		RICH CLEAV	1	10.25	0.75	14 :1		
		TREM CLEAV	1	11.50	0.90	13 :1		
		TREM CLEAV	1	15.00	3.50	4 :1		
		RICH CLEAV	0.5	13.60	3.50	4 :1		
		TREM CLEAV	1	12.25	0.80	15 :1		
		TREM CLEAV	1	22.00	1.15	19 :1		
		TREM CLEAV	1	10.00	0.60	17 :1		
		RICH CLEAV	1	13.00	0.65	20 :1		
		TREM CLEAV	1	35.00	2.50	14 :1		
		TREM CLEAV	1	31.50	0.60	53 :1		
		TREM CLEAV	1	12.50	0.30	42 :1		
		RICH CLEAV	1	14.35	0.30	48 :1		
		TREM CLEAV	1	23.50	0.55	43 :1		
		TREM CLEAV	1	18.50	0.71	26 :1		
		TREM CLEAV	1	22.50	0.45	50 :1		
		RICH CLEAV	0.5	5.50	1.25	4 :1		
		RICH CLEAV	1	7.50	0.40	19 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		RICH CLEAV	1	20.65	0.85	24 :1		
		TREM CLEAV	1	11.50	0.80	14 :1		
		TREM CLEAV	1	28.25	0.75	38 :1		
PM Large Area Removal (3/13/02)	A011278	TREM CLEAV	1	11.00	0.60	18 :1	0	
		TREM CLEAV	1	12.50	1.60	8 :1		
		TREM CLEAV	0.5	17.15	1.25	14 :1		
		RICH CLEAV	0.5	11.65	0.40	29 :1		
		RICH CLEAV	0.5	26.00	0.30	87 :1		
		TREM CLEAV	1	30.50	0.70	44 :1		
		TREM CLEAV	1	17.00	1.10	15 :1		
		RICH CLEAV	0.5	6.25	0.30	21 :1		
		TREM CLEAV	1	5.60	0.35	16 :1		
		TREM CLEAV	1	21.00	0.60	35 :1		
		RICH CLEAV	1	6.65	0.40	17 :1		
		RICH CLEAV	1	20.00	1.60	13 :1		
		TREM CLEAV	0.5	6.00	0.75	8 :1		
		RICH CLEAV	0.5	17.50	2.60	7 :1		
		TREM CLEAV	0.5	22.50	0.60	38 :1		
		TREM CLEAV	0.5	7.50	0.40	19 :1		
		TREM CLEAV	0.5	42.50	1.25	34 :1		
		TREM CLEAV	1	32.50	0.90	36 :1		
		TREM CLEAV	0.5	6.50	0.80	8 :1		
		RICH CLEAV	1	8.50	0.50	17 :1		
		TREM CLEAV	1	9.90	0.35	28 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		TREM CLEAV	1	10.00	0.40	25 :1		
		RICH CLEAV	1	6.00	2.95	2 :1		
		TREM CLEAV	1	7.25	2.50	3 :1		
		TREM CLEAV	1	10.50	0.95	11 :1		
		RICH CLEAV	1	12.50	0.30	42 :1		
		RICH CLEAV	1	8.00	0.40	20 :1		
		TREM CLEAV	1	7.50	0.30	25 :1		
		TREM CLEAV	1	17.00	0.35	49 :1		
		RICH CLEAV	1	15.00	0.35	43 :1		
		TREM CLEAV	1	12.50	1.25	10 :1		
		TREM CLEAV	1	17.50	0.65	27 :1		
PM Large Area Removal (3/13/02)	A011279	RICH ASBFRM	0.5	67.00	1.00	67 :1	0.065	1.46
		RICH ASBFRM	1	6.00	0.65	9 :1		
		RICH CLEAV	1	10.00	0.50	20 :1		
		RICH CLEAV	1	7.00	0.60	12 :1		
		RICH CLEAV	1	10.00	0.50	20 :1		
		TREM CLEAV	1	11.00	1.00	11 :1		
		TREM ASBFRM	1	19.00	0.40	48 :1		
		RICH CLEAV	1	6.00	0.60	10 :1		
		TREM CLEAV	0.5	10.00	2.75	4 :1		
		TREM CLEAV	1	9.50	0.30	32 :1		
		TREM CLEAV	0.5	23.00	0.30	77 :1		
		TREM CLEAV	1	6.00	0.75	8 :1		
		TREM CLEAV	0.5	20.00	0.75	27 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clear)
		RICH CLEAV	1	5.35	2.40	2 :1		
		RICH CLEAV	1	20.00	0.45	44 :1		
		TREM CLEAV	0.5	15.00	0.80	19 :1		
		TREM CLEAV	1	15.50	0.75	21 :1		
		TREM CLEAV	1	15.00	1.50	10 :1		
		TREM CLEAV	1	9.50	2.40	4 :1		
		RICH CLEAV	1	32.60	1.00	33 :1		
PM Large Area Removal (3/13/02)	A011280	TREM ASBFRM	0.5	33.00	1.50	22 :1	0.066	0.59
		TREM CLEAV	0.5	20.00	1.00	20 :1		
		TREM CLEAV	1	18.00	0.50	36 :1		
		TREM CLEAV	0.5	55.00	1.25	44 :1		
		TREM ASBFRM	1	15.00	0.40	38 :1		
		TREM CLEAV	0.5	25.00	0.40	63 :1		
		RICH CLEAV	1	15.00	2.75	5 :1		
		TREM CLEAV	1	10.50	1.00	11 :1		
		RICH CLEAV	0.5	25.50	1.15	22 :1		
		TREM CLEAV	1	8.50	0.85	10 :1		
		TREM CLEAV	1	29.00	0.50	58 :1		
		RICH CLEAV	1	8.00	0.65	12 :1		
		TREM CLEAV	0.5	67.50	0.35	193 :1		
		RICH CLEAV	1	7.25	0.50	15 :1		
		RICH CLEAV	1	10.50	0.65	16 :1		
		RICH CLEAV	0.5	22.50	0.75	30 :1		
		TREM CLEAV	1	8.00	0.50	16 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
PM Large Area Removal (3/13/02)	A011283	TREM CLEAV	1	10.60	0.50	21 :1	0.055	
		TREM CLEAV	1	7.25	0.45	16 :1		
		TREM CLEAV	1	10.50	0.70	15 :1		
		TREM CLEAV	1	18.00	1.00	18 :1		
		TREM CLEAV	1	7.50	0.50	15 :1		
		RICH CLEAV	1	7.50	0.50	15 :1		
		TREM CLEAV	1	12.25	1.00	12 :1		
		TREM CLEAV	1	10.00	0.30	33 :1		
		TREM CLEAV	1	8.50	0.50	17 :1		
		TREM CLEAV	1	12.50	0.70	18 :1		
		TREM CLEAV	1	15.00	0.60	25 :1		
		TREM CLEAV	1	12.50	0.50	25 :1		
		TREM CLEAV	1	18.00	0.50	36 :1		
		RICH CLEAV	0.5	14.50	0.75	19 :1		
		TREM CLEAV	1	14.50	0.80	18 :1		
		TREM CLEAV	1	14.50	0.75	19 :1		
		TREM ASBFRM	1	42.00	0.45	93 :1		
		TREM CLEAV	1	19.95	0.65	31 :1		
		TREM CLEAV	1	6.00	0.50	12 :1		
		RICH CLEAV	1	13.50	1.50	9 :1		
		TREM CLEAV	1	5.25	1.20	4 :1		
		TREM CLEAV	1	13.00	0.60	22 :1		
		TREM CLEAV	1	7.00	0.40	18 :1		
		TREM CLEAV	1	8.00	1.00	8 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	7.50	0.50	15 :1		
		TREM CLEAV	1	9.50	0.50	19 :1		
		TREM CLEAV	1	17.00	0.80	21 :1		
PM Large Area Removal (3/13/02)	A011284	TREM CLEAV	1	10.50	0.35	30 :1	0.052	
		TREM CLEAV	1	13.00	1.25	10 :1		
		RICH CLEAV	0.5	5.75	0.90	6 :1		
		TREM CLEAV	1	7.60	0.40	19 :1		
		TREM CLEAV	1	7.50	0.30	25 :1		
		TREM CLEAV	1	6.35	0.35	18 :1		
		TREM CLEAV	1	16.00	1.55	10 :1		
		TREM CLEAV	1	11.00	0.35	31 :1		
		RICH CLEAV	1	7.50	0.40	19 :1		
		TREM CLEAV	1	8.50	0.80	11 :1		
		TREM ASBFRM	0.5	10.00	1.25	8 :1		
		RICH CLEAV	1	5.50	0.45	12 :1		
		TREM CLEAV	1	10.75	1.00	11 :1		
		RICH CLEAV	1	5.50	0.80	7 :1		
		TREM CLEAV	1	27.00	0.80	34 :1		
		TREM CLEAV	1	11.00	0.40	28 :1		
		TREM CLEAV	0.5	10.00	0.35	29 :1		
		TREM CLEAV	0.5	9.00	1.00	9 :1		
		RICH CLEAV	0.5	8.00	1.50	5 :1		
		TREM CLEAV	0.5	6.50	1.00	7 :1		
		TREM CLEAV	1	20.75	0.80	26 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
		TREM CLEAV	1	9.00	0.75	12 :1		
		TREM CLEAV	1	15.00	0.70	21 :1		
		TREM CLEAV	1	9.00	0.30	30 :1		
		TREM CLEAV	1	8.00	0.75	11 :1		
		RICH CLEAV	1	26.00	1.00	26 :1		
		RICH CLEAV	1	6.00	0.30	20 :1		
AM Background (3/14/02)	A011296	TREM CLEAV	1	14.50	0.60	24 :1	0	
Cleaning (3/14/02)	A011307	RICH CLEAV	1	8.00	1.25	6 :1	0.002	
Cleaning (3/14/02)	A011308	RICH CLEAV	1	14.75	0.30	49 :1	0.003	
		RICH CLEAV	1	20.00	1.00	20 :1		
		TREM CLEAV	1	8.50	0.80	11 :1		
		TREM CLEAV	1	7.50	0.65	12 :1		
		TREM CLEAV	1	11.00	0.40	28 :1		
		RICH ASBFRM	1	10.00	0.75	13 :1		
		RICH CLEAV	1	12.35	1.50	8 :1		
		TREM CLEAV	1	8.50	0.50	17 :1		
		TREAM CLEAV	1	9.50	2.30	4 :1		
		TREM CLEAV	1	11.75	1.00	12 :1		
		TREM CLEAV	1	7.00	0.40	18 :1		
Cleaning (3/14/02)	A011309	RICH ASBFRM	0.5	32.00	1.00	32 :1	0	
		RICH ASBFRM	0.5	27.50	0.50	55 :1		
		RICH CLEAV	1	20.25	1.00	20 :1		
		RICH CLEAV	1	15.00	1.00	15 :1		
		RICH CLEAV	1	10.00	0.90	11 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Cleav)
		RICH CLEAV	1	14.50	1.00	15 :1		
		TREM CLEAV	1	21.50	0.50	43 :1		
		TREM CLEAV	1	6.00	0.40	15 :1		
		TREM CLEAV	0.5	27.00	2.00	14 :1		
		RICH CLEAV	1	10.50	0.50	21 :1		
		RICH CLEAV	0.5	15.00	2.00	8 :1		
Cleaning (3/14/02)	A011311	TREM CLEAV	0.5	29.50	1.00	30 :1	0	
Cleaning (3/14/02)	A011312	RICH CLEAV	1	17.50	1.20	15 :1	0.01	
		TREM CLEAV	0.5	8.50	0.50	17 :1		
		TREM CLEAV	1	8.00	0.45	18 :1		
		TREM CLEAV	1	6.25	0.80	8 :1		
		TREM ASBFRM	0.5	22.75	0.45	51 :1		
		TREM CLEAV	0.5	11.50	0.80	14 :1		
		TREM CLEAV	1	9.00	0.55	16 :1		
Cleaning (3/14/02)	A011313	TREM CLEAV	1	9.00	0.50	18 :1	0	
		TREM CLEAV	0.5	5.85	1.00	6 :1		
		TREM CLEAV	0.5	7.50	0.55	14 :1		
		TREM CLEAV	1	8.00	0.90	9 :1		
		TREM CLEAV	1	12.25	0.50	25 :1		
Cleaning (3/14/02)	A011318	RICH CLEAV	1	7.50	0.75	10 :1	0	
		RICH CLEAV	1	13.50	0.60	23 :1		
		TREM CLEAV	1	9.50	0.35	27 :1		
		TREM CLEAV	0.5	25.00	0.65	38 :1		
		TREM CLEAV	1	7.75	0.30	26 :1		

R.J. Lee Group Data (NIOSH 7402 TEM) Dimensions and Distributions of Fibers

ACTIVITY	SAMPLE NO.	FIBER TYPE	FIBER	FIBER LENGTH	FIBER WIDTH	ASPECT RATIO	ASB. CONC. (Lee)	ASB. CONC. (Incl./Clea v)
Cleaning (3/14/02)	A011319	TREM CLEAV	1	5.75	0.40	14 :1	0	
		TREM CLEAV	0.5	7.50	1.00	8 :1		
		TREM CLEAV	0.5	7.00	0.60	12 :1		

CODE OF FEDERAL REGULATIONS
TITLE 40--PROTECTION OF ENVIRONMENT
CHAPTER I--ENVIRONMENTAL PROTECTION AGENCY
SUBCHAPTER R--TOXIC SUBSTANCES CONTROL ACT
PART 763--ASBESTOS
SUBPART E--ASBESTOS-CONTAINING MATERIALS IN SCHOOLS
Current through May 7, 2003; 68 FR 24603

Appendix A to Subpart E--Interim Transmission Electron Microscopy Analytical Methods--Mandatory and Nonmandatory--and Mandatory Section to Determine Completion of Response Actions

I. Introduction

The following appendix contains three units. The first unit is the mandatory transmission electron microscopy (TEM) method which all laboratories must follow; it is the minimum requirement for analysis of air samples for asbestos by TEM. The mandatory method contains the essential elements of the TEM method. The second unit contains the complete non-mandatory method. The non-mandatory method supplements the mandatory method by including additional steps to improve the analysis. EPA recommends that the non-mandatory method be employed for analyzing air filters; however, the laboratory may choose to employ the mandatory method. The non-mandatory method contains the same minimum requirements as are outlined in the mandatory method. Hence, laboratories may choose either of the two methods for analyzing air samples by TEM.

The final unit of this Appendix A to Subpart E defines the steps which must be taken to determine completion of response actions. This unit is mandatory.

II. Mandatory Transmission Electron Microscopy Method

A. Definitions of Terms

1. "Analytical sensitivity"--Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 structures/cm super3 .

2. "Asbestiform"--A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. "Aspect ratio"--A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. "Bundle"--A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. "Clean area"--A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm super2 in an area of 0.057 mm super2 (nominally 10 200-mesh grid openings) and a maximum of 53 structures/mm super2 for any single preparation for that same area.

6. "Cluster"--A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

7. "ED"--Electron diffraction.

8. "EDXA"--Energy dispersive X-ray analysis.

9. "Fiber"--A structure greater than or equal to 0.5 mu m in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. "Grid"--An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. "Intersection"--Nonparallel touching or

crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. "Laboratory sample coordinator"—That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. "Filter background level"—The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on a blank (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm (superscript 2).

14. "Matrix"—Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. "NSD"—No structure detected.

16. "Operator"—A person responsible for the TEM instrumental analysis of the sample.

17. "PCM"—Phase contrast microscopy.

18. "SAED"—Selected area electron diffraction.

19. "SEM"—Scanning electron microscope.

20. "STEM"—Scanning transmission electron microscope.

21. "Structure"—A microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. "S/cm (superscript 3) "—Structures per cubic centimeter.

23. S/mm (superscript 2)"—Structures per square millimeter.

24. "TEM"—Transmission electron microscope.

B. Sampling

1. The sampling agency must have written quality control procedures and documents which verify compliance.

2. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (References 1, 2, 3, and 5 of Unit II.J.).

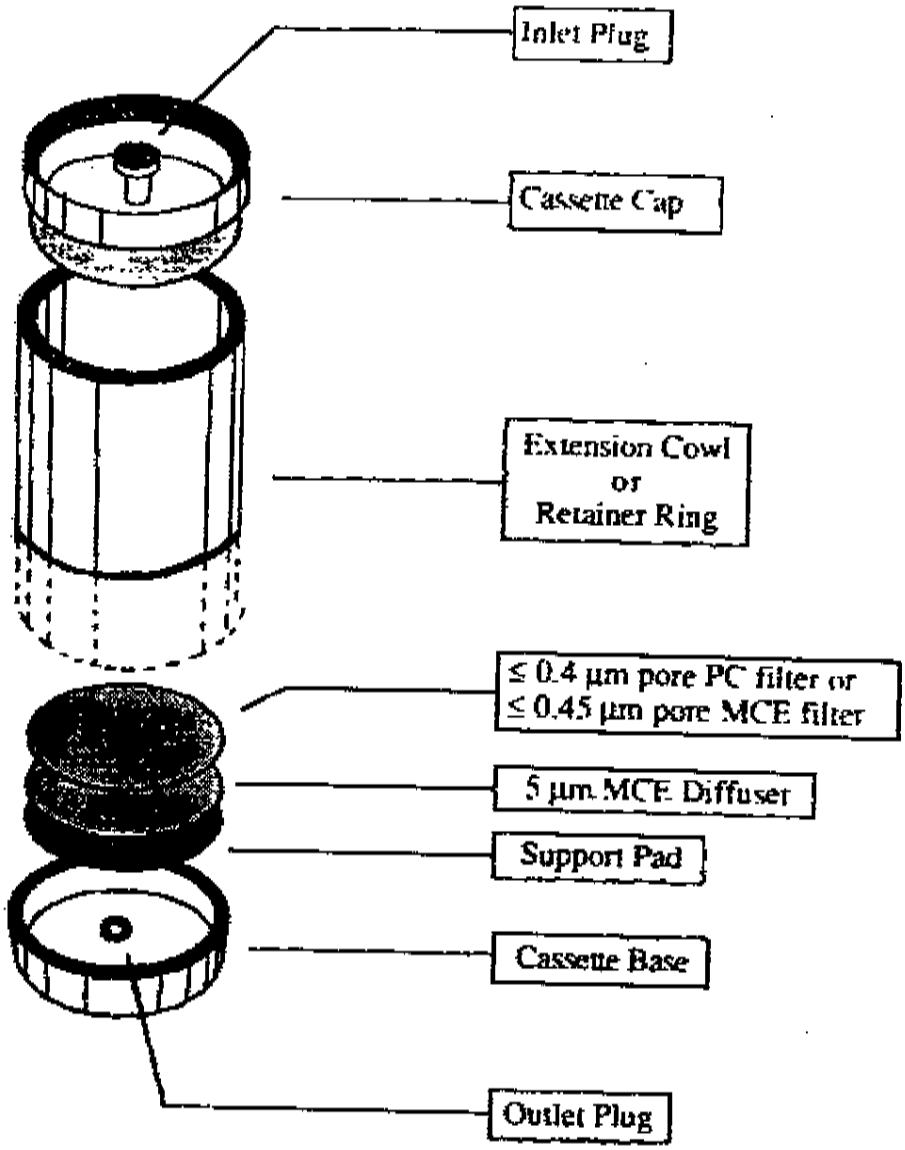
3. Sampling for airborne asbestos following an abatement action must use commercially available cassettes.

4. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm super2 in an area of 0.057 mm super2 (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm super2 for that same area is acceptable for this method.

5. Use sample collection filters which are either polycarbonate having a pore size less than or equal to 0.4 mu m or mixed cellulose ester having a pore size less than or equal to 0.45 mu m.

6. Place these filters in series with a 5.0 mu m backup filter (to serve as a diffuser) and a support pad. See the following Figure 1:

FIGURE 1--SAMPLING CASSETTE CONFIGURATION



7. Reloading of used cassettes is not permitted.

8. Orient the cassette downward at approximately 45 degrees from the horizontal.

9. Maintain a log of all pertinent sampling information.

10. Calibrate sampling pumps and their flow indicators over the range of their intended use with

a recognized standard. Assemble the sampling system with a representative filter (not the filter which will be used in sampling) before and after the sampling operation.

11. Record all calibration information.

12. Ensure that the mechanical vibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

13. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by damping out any pump action fluctuations if necessary.

14. The final plastic barrier around the abatement area remains in place for the sampling period.

15. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust. (See suggested protocol in Unit III.B.7.d.)

16. Select an appropriate flow rate equal to or greater than 1 liter per minute (L/min) or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

17. A minimum of 13 samples are to be collected for each testing site consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 seconds and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each abatement area.

ii. At one of the ambient sites. (DO NOT leave the field blanks open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

18. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

19. The following Table I specifies volume ranges to be used:

TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS (0.0057 MM super2) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA

	Effective Filter Area 385 sq mm	
	Volume (liters)	# of grid openings
	560	24
	600	23
	700	19
	800	17
	900	15
	1,000	14
	1,100	12
:		
:	1,200	
Recommended	1,300	11
Volume	1,400	10
	1,500	10
Range		9
:	1,600	
:	1,700	8
	1,800	8
	1,900	8
	2,000	7
	2,100	7
	2,200	6
	2,300	6
	2,400	6
	2,500	6
	2,600	5
	2,700	5
	2,800	5
	2,900	5
	3,000	5
	3,100	5
	3,200	4
	3,300	4
	3,400	4
	3,500	4
		4
	3,600	
	3,700	4
	3,800	4
		4

	Effective Filter Area 855 sq mm	
	Volume (liters)	# of grid openings

	1,250	24
	1,300	23
	1,400	21
	1,600	19
	1,800	17
	2,000	15
	2,200	14
	2,400	13
	2,600	12
	2,800	11
Recommended Volume Range	3,000	10
	3,200	9
	3,400	9
	3,600	8
	3,800	8
	4,000	8
	4,200	7
	4,400	7
	4,600	7
	4,800	6
	5,000	6
	5,200	6
	5,400	6
	5,600	5
	5,800	5
	6,000	5
	6,200	5
	6,400	5
	6,600	5
	6,800	4
	7,000	4
	7,200	4
	7,400	4
	7,600	4

Note minimum volumes required:
25 mm: 560 liters
37 mm: 1250 liters
Filter diameter of 25 mm = effective area of 385 sq mm
Filter diameter of 37 mm = effective area of 855 sq mm

20. Ensure that the sampler is turned upright before interrupting the pump flow.

21. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

22. Ensure that the samples are stored in a secure and representative location.

23. Do not change containers if portions of these filters are taken for other purposes.

24. A summary of Sample Data Quality Objectives is shown in the following Table II:

TABLE II--SUMMARY OF SAMPLING AGENCY DATA QUALITY OBJECTIVES

This table summarizes the data quality objectives from the performance of this method in terms of precision, accuracy, completeness, representativeness, and comparability. These objectives are assured by the periodic control checks and reference checks listed here and described in the text of the method.

Unit Operation	QC Check	Frequency	Conformance Expectation
Sampling materials	Sealed blank	1 per I/O site	95%
Sample procedures	Field blanks	2 per I/O site	95%
	Pump calibration	Before and after each field series	90%
Sample custody	Review of chain-of-custody record	Each sample	95% complete.
Sample shipment	Review of sending report	Each sample	95% complete

C. Sample Shipment

Ship bulk samples to the analytical laboratory in a separate container from air samples.

D. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

E. Sample Preparation

1. All sample preparation and analysis shall be performed by a laboratory independent of the abatement contractor.

2. Wet-wipe the exterior of the cassettes to minimize contamination possibilities before taking them into the clean room facility.

3. Perform sample preparation in a well-equipped clean facility.

Note: The clean area is required to have the following minimum characteristics. The area or hood must be capable of maintaining a positive pressure with make-up air being HEPA-filtered. The cumulative analytical blank concentration must average less than 18 s/mm super2 in an area of 0.057 mm super2 (nominally 10 200-mesh grid openings) and a single preparation with a maximum of 53 s/mm super2 for that same area.

4. Preparation areas for air samples must not only be separated from preparation areas for bulk samples, but they must be prepared in separate rooms.

5. Direct preparation techniques are required. The object is to produce an intact film containing the particulates of the filter surface which is sufficiently clear for TEM analysis.

a. TEM Grid Opening Area measurement must be done as follows:

i. The filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique.

ii. Measure 20 grid openings on each of 20 random 200-mesh copper grids by placing a grid on a glass and examining it under the PCM. Use a calibrated graticule to measure the average field diameters. From the data, calculate the field area for an average grid opening.

iii. Measurements can also be made on the TEM at a properly calibrated low magnification or on an optical microscope at a magnification of approximately 400X by using an eyepiece fitted with a scale that has been calibrated against a stage micrometer. Optical microscopy utilizing manual or automated procedures may be used providing instrument calibration can be verified.

b. TEM specimen preparation from polycarbonate (PC) filters. Procedures as described in Unit III.G. or other equivalent methods may be used.

c. TEM specimen preparation from mixed cellulose ester (MCE) filters.

i. Filter portion being used for sample preparation must have the surface collapsed using an acetone vapor technique or the Burdette procedure (Ref. 7 of Unit II.J.)

ii. Plasma etching of the collapsed filter is required. The microscope slide to which the collapsed filter pieces are attached is placed in a plasma asher. Because plasma ashers vary greatly in their performance, both from unit to unit and between different positions in the asher chamber, it is difficult to specify the conditions that should be used. Insufficient etching will result in a failure to expose embedded filters, and too much etching may result in loss of particulate from the surface. As an interim measure, it is recommended that the time for ashing of a known weight of a collapsed filter be established and that the etching rate be calculated in terms of micrometers per second. The actual etching time used for the particulate asher and operating conditions will then be set such that a 1-2 mu m (10 percent) layer of collapsed surface will be removed.

iii. Procedures as described in Unit III. or other equivalent methods may be used to prepare samples.

F. TEM Method

1. An 80-120 kV TEM capable of performing electron diffraction with a fluorescent screen inscribed with calibrated gradations is required. If the TEM is equipped with EDXA it must either have a STEM attachment or be capable of producing a spot less than 250 nm in diameter at crossover. The microscope shall be calibrated routinely for magnification and camera constant.

2. Determination of Camera Constant and ED Pattern Analysis. The camera length of the TEM in ED operating mode must be calibrated before ED patterns on unknown samples are observed. This can be achieved by using a carbon-coated grid on which a thin film of gold has been sputtered or evaporated. A thin film of gold is evaporated on the specimen TEM grid to obtain zone-axis ED patterns superimposed with a ring pattern from the polycrystalline gold film. In practice, it is desirable to optimize the thickness of the gold film so that only one or two sharp rings are obtained on the superimposed ED pattern. Thicker gold film would normally give multiple gold rings, but it will tend to mask weaker diffraction spots from the unknown fibrous particulate. Since the unknown d-spacings of most interest in asbestos analysis are those which lie closest to the transmitted beam, multiple gold rings are unnecessary on zone- axis ED patterns. An average camera constant using multiple gold rings can be determined. The camera constant is one-half the diameter of the rings times the interplanar spacing of the ring being measured.

3. Magnification Calibration. The magnification calibration must be done at the fluorescent screen. The TEM must be calibrated at the grid opening magnification (if used) and also at the magnification used for fiber counting. This is performed with a cross grating replica (e.g., one containing 2,160 lines/mm). Define a field of view on the fluorescent screen either by markings or physical boundaries. The field of view must be measurable or previously inscribed with a scale or concentric circles (all scales should be metric). A logbook must be maintained, and the dates of calibration and the values obtained must be recorded. The frequency of calibration depends on the past history of the particular microscope. After any maintenance of the microscope that involved adjustment of the power supplied to the lenses or the high- voltage system or the mechanical disassembly of the electron optical column apart from filament exchange, the magnification must be recalibrated. Before the TEM calibration is performed, the analyst must ensure that the cross grating replica is placed at the same distance from the objective lens as the specimens are. For instruments that incorporate an eucentric tilting specimen stage, all specimens and the cross grating replica must be placed at the eucentric position.

4. While not required on every microscope in the laboratory, the laboratory must have either one microscope equipped with energy dispersive X-ray analysis or access to an equivalent system on a TEM in another laboratory.

5. Microscope settings: 80-120 kV, grid assessment 250-1,000X, then 15,000- 20,000X screen magnification for analysis.

6. Approximately one-half (0.5) of the predetermined sample area to be analyzed shall be performed on one sample grid preparation and the remaining half on a second sample grid preparation.

7. Individual grid openings with greater than 5 percent openings (holes) or covered with greater than 25 percent particulate matter or obviously having nonuniform loading must not be analyzed.

8. Reject the grid if:

a. Less than 50 percent of the grid openings covered by the replica are intact.

b. The replica is doubled or folded.

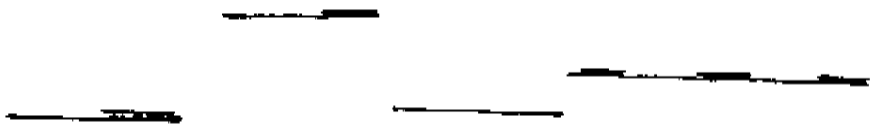
c. The replica is too dark because of incomplete dissolution of the filter.

9. Recording Rules.

a. Any continuous grouping of particles in which an asbestos fiber with an aspect ratio greater than or equal to 5:1 and a length greater than or equal to 0.5 mu m is detected shall be recorded on the count sheet. These will be designated asbestos structures and will be classified as fibers, bundles, clusters, or matrices. Record as individual fibers any contiguous grouping having 0, 1, or 2 definable intersections. Groupings having more than 2 intersections are to be described as cluster or matrix. An intersection is a nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater. See the following Figure 2:

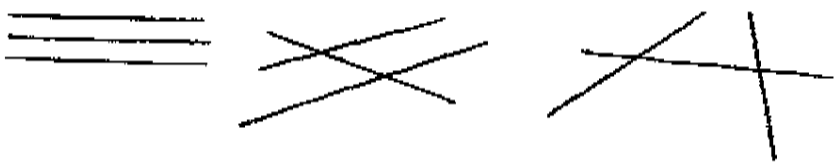
FIGURE 2--COUNTING GUIDELINES USED IN DETERMINING ASBESTOS STRUCTURES

Count as 1 fiber; 1 Structure; no intersections.

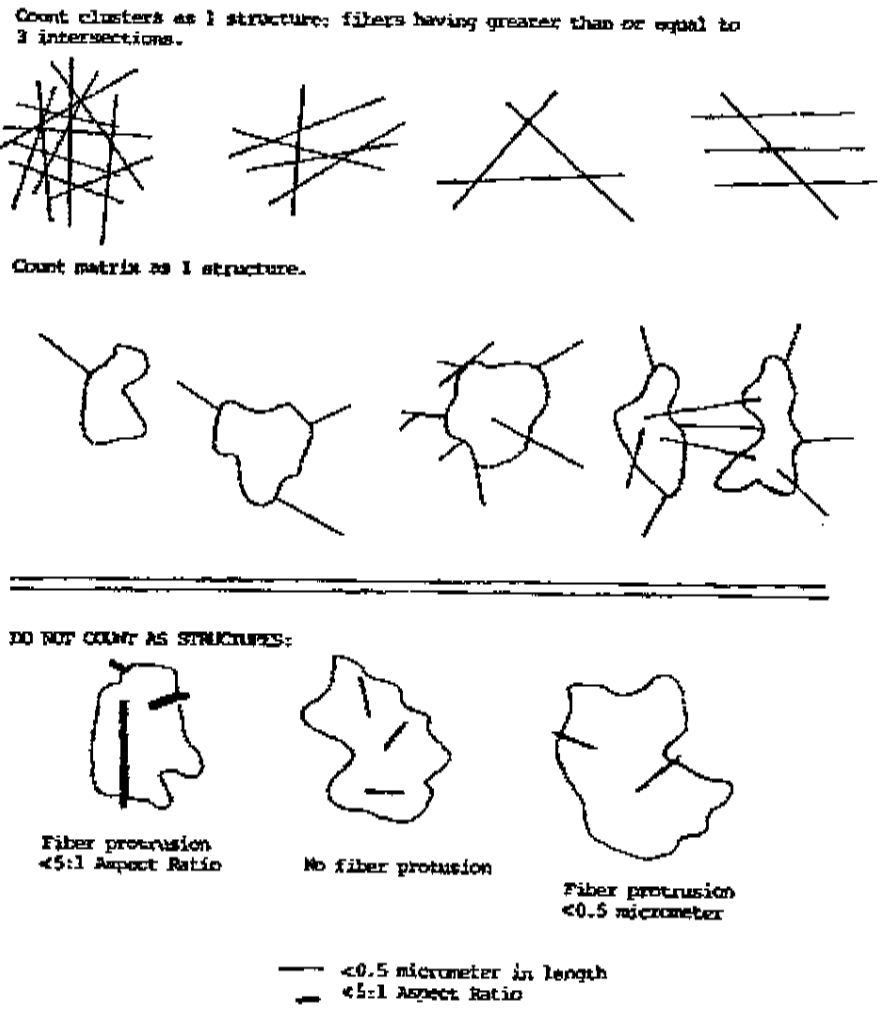


Count as 2 fibers if space between fibers is greater than width of 1 fiber diameter or number of intersections is equal to or less than 1.

Count as 3 structures if space between fibers is greater than width of 1 fiber diameter or if the number of intersections is equal to or less than 2.



Count bundles as 1 structure; 3 or more parallel fibrils less than 1 fiber diameter separation.



i. Fiber. A structure having a minimum length greater than or equal to 0.5 mu m and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

ii. Bundle. A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

iii. Cluster. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

iv. Matrix. Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

b. Separate categories will be maintained for fibers less than 5 mu m and for fibers equal to or greater than 5 mu m in length.

c. Record NSD when no structures are detected in the field.

d. Visual identification of electron diffraction (ED) patterns is required for each asbestos structure counted which would cause the analysis to exceed

the 70 s/mm super2 concentration. (Generally this means the first four fibers identified as asbestos must exhibit an identifiable diffraction pattern for chrysotile or amphibole.)

e. The micrograph number of the recorded diffraction patterns must be reported to the client and maintained in the laboratory's quality assurance records. In the event that examination of the pattern by a qualified individual indicates that the pattern has been misidentified visually, the client shall be contacted.

f. Energy Dispersive X-ray Analysis (EDXA) is required of all amphiboles which would cause the analysis results to exceed the 70 s/mm super2 concentration. (Generally speaking, the first 4 amphiboles would require EDXA.)

g. If the number of fibers in the nonasbestos class would cause the analysis to exceed the 70 s/mm super2 concentration, the fact that they are not asbestos must be confirmed by EDXA or measurement of a zone axis diffraction pattern.

h. Fibers classified as chrysotile must be identified by diffraction or X-ray analysis and recorded on a **count** sheet. X-ray analysis alone can be used only after 70 s/mm super2 have been exceeded for a particular sample.

i. Fibers classified as amphiboles must be identified by X-ray analysis and electron diffraction and recorded on the **count** sheet. (X-ray analysis alone can be used only after 70 s/mm super2 have been exceeded for a particular sample.)

j. If a diffraction pattern was recorded on film, record the micrograph number on the **count** sheet.

k. If an electron diffraction was attempted but no pattern was observed, record N on the **count** sheet.

l. If an EDXA spectrum was attempted but not observed, record N on the **count** sheet.

m. If an X-ray analysis spectrum is stored, record the file and disk number on the **count** sheet.

10. Classification Rules.

a. Fiber. A structure having a minimum length greater than or equal to 0.5 mu m and an aspect ratio (length to width) of 5:1 or greater and substantially parallel sides. Note the appearance of the end of the fiber, i.e., whether it is flat, rounded or dovetailed.

b. Bundle. A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

c. Cluster. A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

d. Matrix. Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

11. After finishing with a grid, remove it from the microscope, and replace it in the appropriate grid holder. Sample grids must be stored for a minimum of 1 year from the date of the analysis; the sample cassette must be retained for a minimum of 30 days by the laboratory or returned at the client's request.

G. Sample Analytical Sequence

1. Under the present sampling requirements a minimum of 13 samples is to be collected for the clearance testing of an abatement site. These include five abatement area samples, five ambient samples, two field blanks, and one sealed blank.

2. Carry out visual inspection of work site prior to air monitoring.

3. Collect a minimum of 5 air samples inside the work site and 5 samples outside the work site. The indoor and outdoor samples shall be taken during the same time period.

4. Remaining steps in the analytical sequence are contained in Unit IV of this Appendix.

H. Reporting

1. The following information must be reported to the client for each sample analyzed:

a. Concentration in structures per square millimeter and structures per cubic centimeter.

b. Analytical sensitivity used for the analysis.

c. Number of asbestos structures.

d. Area analyzed.

e. Volume of air sampled (which must be initially supplied to lab by client).

f. Copy of the **count** sheet must be included with the report.

g. Signature of laboratory official to indicate that the laboratory met specifications of the method.

h. Report form must contain official laboratory identification (e.g., letterhead).

i. Type of asbestos.

I. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards are to be performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the following Table III:

TABLE III--SUMMARY OF LABORATORY DATA QUALITY OBJECTIVES

Unit Operation	QC Check	Frequency	Conformance Expectation
Sample	Review of receiving report	Each sample	95% complete

	receiving		
Sample custody	Review of chain-of-custody record	Each sample	95% complete
Sample preparation	Supplies and reagents	On receipt	Meet specs. or reject
	Grid opening size	20 openings/20 grids/lot of 1000 or 1 opening/sample	100%
	Special clean area monitoring	After cleaning or service	Meet specs. or reclean
	Laboratory blank	1 per prep series or 10%	Meet specs. or reanalyze series
	Plasma etch blank	1 per 20 samples	75%
	Multiple preps (3 per sample)	Each sample	One with cover of 15 complete grid sqs.
Sample analysis	System check	Each day	Each day
	Alignment check	Each day	Each day
	Magnification calibration with low and high standards	Each month or after service	95%
	ED calibration by gold standard	Weekly	95%
	EDS calibration by copper line	Daily	95%
Performance check	Laboratory blank (measure of cleanliness)	Prep 1 per series or 10%	Meet specs. or reanalyze series
		read 1 per 25 samples	
	Replicate counting (measure of precision)	1 per 100 samples	1.5 x Poisson Std. Dev.
	Duplicate analysis (measure of reproducibility)	1 per 100 samples	2 x Poisson Std. Dev.
	Known samples of typical materials (working standards)	Training and for comparison with unknowns	100%
	Analysis of NBS SRM 1876 and/or RM 8410 (measure of accuracy and comparability)	1 per analyst per year	1.5 x Poisson Std. Dev.
	Data entry review (data validation and measure of completeness)	Each sample	95%
	Record and verify ID electron diffraction pattern of structure	1 per 5 samples	80% accuracy
Calculations and data	Hand calculation of automated data reduction procedure or	1 per 100 samples	85%

reduction	independent recalculation of hand-calculated data

1. When the samples arrive at the laboratory, check the samples and documentation for completeness and requirements before initiating the analysis.

2. Check all laboratory reagents and supplies for acceptable asbestos background levels.

3. Conduct all sample preparation in a clean room environment monitored by laboratory blanks. Testing with blanks must also be done after cleaning or servicing the room.

4. Prepare multiple grids of each sample.

5. Provide laboratory blanks with each sample batch. Maintain a cumulative average of these results. If there are more than 53 fibers/mm super2 per 10 200-mesh grid openings, the system must be checked for possible sources of contamination.

6. Perform a system check on the transmission electron microscope daily.

7. Make periodic performance checks of magnification, electron diffraction and energy dispersive X-ray systems as set forth in Table III under Unit II.I.

8. Ensure qualified operator performance by evaluation of replicate analysis and standard sample comparisons as set forth in Table III under Unit II.I.

9. Validate all data entries.

10. Recalculate a percentage of all computations and automatic data reduction steps as specified in Table III under Unit II.I.

11. Record an electron diffraction pattern of one asbestos structure from every five samples that contain asbestos. Verify the identification of the pattern by measurement or comparison of the pattern with patterns collected from standards under the same conditions. The records must also demonstrate that the identification of the pattern has been verified by a qualified individual and that the operator who made the identification is maintaining at least an 80 percent correct visual identification based on his measured patterns.

12. Appropriate logs or records must be maintained by the analytical laboratory verifying that it is in compliance with the mandatory quality assurance procedures.

J. References

For additional background information on this method, the following references should be consulted.

1. "Guidance for Controlling Asbestos-Containing Materials in Buildings," EPA 56/0/5-85-024, June 1985.

2. "Measuring Airborne Asbestos Following an Abatement Action," USEPA, Office of Pollution Prevention and Toxics, EPA 600/4-85-049, 1985.

3. Small, John and E. Steel. Asbestos Standards: Materials and Analytical Methods. N.B.S. Special Publication 619, 1982.

4. Campbell, W.J., R.L. Blake, L.L. Brown, E.E. Cather, and J.J. Sjoberg. Selected Silicate Minerals and Their Asbestiform Varieties. Information Circular 8751, U.S. Bureau of Mines, 1977.

5. Quality Assurance Handbook for Air Pollution Measurement System. Ambient Air Methods, EPA 600/4-77-027a, USEPA, Office of Research and Development, 1977.

6. Method 2A: Direct Measurement of Gas Volume through Pipes and Small Ducts. 40 CFR Part 60 Appendix A.

7. Burdette, G.J., Health & Safety Exec. Research & Lab. Services Div., London, "Proposed Analytical Method for Determination of Asbestos in Air."

8. Chatfield, E.J., Chatfield Tech. Cons., Ltd., Clark, T., PEI Assoc., "Standard Operating Procedure for Determination of Airborne Asbestos Fibers by Transmission Electron Microscopy Using Polycarbonate Membrane Filters," WERL SOP 87-1, March 5, 1987.

9. NIOSH Method 7402 for Asbestos Fibers, 12-11-86 Draft.

10. Yamate, G., Agarwall, S.C., Gibbons, R.D., IIT Research Institute, "Methodology for the Measurement of Airborne Asbestos by Electron Microscopy," Draft report, USEPA Contract 68-02-3266, July 1984.

11. "Guidance to the Preparation of Quality Assurance Project Plans," USEPA, Office of Pollution Prevention and Toxics, 1984.

III. Nonmandatory Transmission Electron Microscopy Method

A. Definitions of Terms

1. "Analytical sensitivity"--Airborne asbestos concentration represented by each fiber counted under the electron microscope. It is determined by the air volume collected and the proportion of the filter examined. This method requires that the analytical sensitivity be no greater than 0.005 s/cm super3 .

2. "Asbestiform"--A specific type of mineral fibrosity in which the fibers and fibrils possess high tensile strength and flexibility.

3. "Aspect ratio"--A ratio of the length to the width of a particle. Minimum aspect ratio as defined by this method is equal to or greater than 5:1.

4. "Bundle"--A structure composed of three or more fibers in a parallel arrangement with each fiber closer than one fiber diameter.

5. "Clean area"--A controlled environment which is maintained and monitored to assure a low probability of asbestos contamination to materials in that space. Clean areas used in this method have HEPA filtered air under positive pressure and are capable of sustained operation with an open laboratory blank which on subsequent analysis has an average of less than 18 structures/mm super2 in an area of 0.057 mm super2 (nominally 10 200 mesh grid openings) and a maximum of 53 structures/mm super2 for no more than one single preparation for that same area.

6. "Cluster"--A structure with fibers in a random arrangement such that all fibers are intermixed and no single fiber is isolated from the group. Groupings must have more than two intersections.

7. "ED"--Electron diffraction.

8. "EDXA"--Energy dispersive X-ray analysis.

9. "Fiber"--A structure greater than or equal to 0.5 mu m in length with an aspect ratio (length to width) of 5:1 or greater and having substantially parallel sides.

10. "Grid"--An open structure for mounting on the sample to aid in its examination in the TEM. The term is used here to denote a 200-mesh copper lattice approximately 3 mm in diameter.

11. "Intersection"--Nonparallel touching or crossing of fibers, with the projection having an aspect ratio of 5:1 or greater.

12. "Laboratory sample coordinator"--That person responsible for the conduct of sample handling and the certification of the testing procedures.

13. "Filter background level"--The concentration of structures per square millimeter of filter that is considered indistinguishable from the concentration measured on blanks (filters through which no air has been drawn). For this method the filter background level is defined as 70 structures/mm super2 .

14. "Matrix"--Fiber or fibers with one end free and the other end embedded in or hidden by a particulate. The exposed fiber must meet the fiber definition.

15. "NSD"--No structure detected.

16. "Operator"--A person responsible for the TEM instrumental analysis of the sample.

17. "PCM"--Phase contrast microscopy.

18. "SAED"--Selected area electron diffraction.

19. "SEM"--Scanning electron microscope.

20. "STEM"--Scanning transmission electron microscope.

21. "Structure"—A microscopic bundle, cluster, fiber, or matrix which may contain asbestos.

22. "S/cm super3 "—Structures per cubic centimeter.

23. "S/mm super2 "—Structures per square millimeter.

24. "TEM"—Transmission electron microscope.

B. Sampling

1. Sampling operations must be performed by qualified individuals completely independent of the abatement contractor to avoid possible conflict of interest (See References 1, 2, and 5 of Unit III.L.) Special precautions should be taken to avoid contamination of the sample. For example, materials that have not been prescreened for their asbestos background content should not be used; also, sample handling procedures which do not take cross contamination possibilities into account should not be used.

2. Material and supply checks for asbestos contamination should be made on all critical supplies, reagents, and procedures before their use in a monitoring study.

3. Quality control and quality assurance steps are needed to identify problem areas and isolate the cause of the contamination (see Reference 5 of Unit III.L.). Control checks shall be permanently recorded to document the quality of the information produced. The sampling firm must have written quality control procedures and documents which verify compliance. Independent audits by a qualified consultant or firm should be performed once a year. All documentation of compliance should be retained indefinitely to provide a guarantee of quality. A summary of Sample Data Quality Objectives is shown in Table II of Unit II.B.

4. Sampling materials.

a. Sample for airborne asbestos following an abatement action using commercially available cassettes.

b. Use either a cowling or a filter-retaining middle piece. Conductive material may reduce the potential for particulates to adhere to the walls of the cowl.

c. Cassettes must be verified as "clean" prior to use in the field. If packaged filters are used for loading or preloaded cassettes are purchased from the manufacturer or a distributor, the manufacturer's name and lot number should be entered on all field data sheets provided to the laboratory, and are required to be listed on all reports from the laboratory.

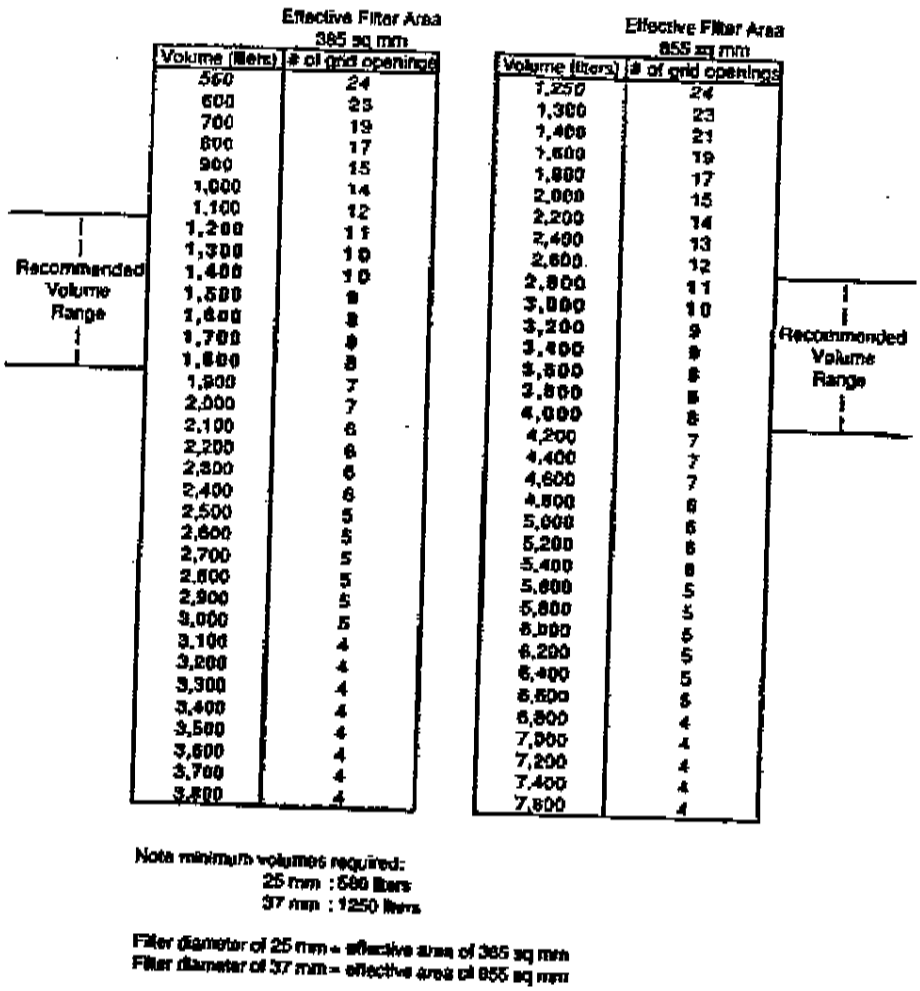
d. Assemble the cassettes in a clean facility (See definition of clean area under Unit III.A.).

e. Reloading of used cassettes is not permitted.

f. Use sample collection filters which are either polycarbonate having a pore size of less than or equal to 0.4 mu m or mixed cellulose ester having a pore size of less than or equal to 0.45 mu m.

g. Place these filters in series with a backup filter with a pore size of 5.0 mu m (to serve as a diffuser) and a support pad. See the following Figure 1:

TABLE 1--NUMBER OF 200 MESH EM GRID OPENINGS ($0.0057\ MM^2$) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA



h. When polycarbonate filters are used, position the highly reflective face such that the incoming particulate is received on this surface.

i. Seal the cassettes to prevent leakage around the filter edges or between cassette part joints. A mechanical press may be useful to achieve a reproducible leak-free seal. Shrink fit gel-bands may be used for this purpose and are available from filter manufacturers and their authorized distributors.

j. Use wrinkle-free loaded cassettes in the sampling operation.

5. Pump setup.

a. Calibrate the sampling pump over the range of flow rates and loads anticipated for the monitoring period with this flow measuring device in series. Perform this calibration using guidance from EPA Method 2A each time the unit is sent to the field (See Reference 6 of Unit III.L.).

b. Configure the sampling system to preclude pump

vibrations from being transmitted to the cassette by using a sampling stand separate from the pump station and making connections with flexible tubing.

c. Maintain continuous smooth flow conditions by damping out any pump action fluctuations if necessary.

d. Check the sampling system for leaks with the end cap still in place and the pump operating before initiating sample collection. Trace and stop the source of any flow indicated by the flowmeter under these conditions.

e. Select an appropriate flow rate equal to or greater than 1 L/min or less than 10 L/min for 25 mm cassettes. Larger filters may be operated at proportionally higher flow rates.

f. Orient the cassette downward at approximately 45 degrees from the horizontal.

g. Maintain a log of all pertinent sampling information, such as pump identification number, calibration data, sample location, date, sample identification number, flow rates at the beginning, middle, and end, start and stop times, and other useful information or comments. Use of a sampling log form is recommended. See the following Figure 2:

FIGURE 2--SAMPLING LOG FORM

Sample Number	Location of Sample	Pump I.D.	Start Time	Middle Time	End Time	Flow Rate

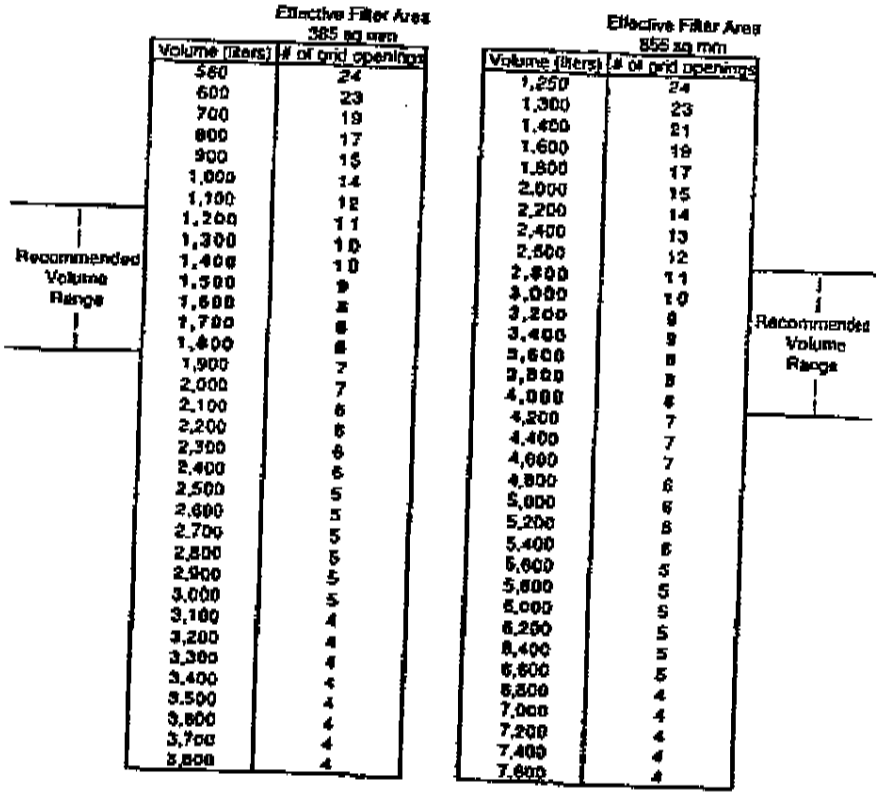
Inspector: _____ Date: _____

h. Initiate a chain of custody procedure at the start of each sampling, if this is requested by the client.

i. Maintain a close check of all aspects of the sampling operation on a regular basis.

j. Continue sampling until at least the minimum volume is collected, as specified in the following Table I:

TABLE 1--NUMBER OF 200 MESH BM GRID OPENINGS (0.0057 MM^2) THAT NEED TO BE ANALYZED TO MAINTAIN SENSITIVITY OF 0.005 STRUCTURES/CC BASED ON VOLUME AND EFFECTIVE FILTER AREA



Volume (liters)	# of grid openings
560	24
600	23
700	19
800	17
900	15
1,000	14
1,100	12
1,200	11
1,300	10
1,400	10
1,500	9
1,600	8
1,700	8
1,800	8
1,900	7
2,000	7
2,100	6
2,200	6
2,300	6
2,400	6
2,500	5
2,600	5
2,700	5
2,800	5
2,900	5
3,000	5
3,100	4
3,200	4
3,300	4
3,400	4
3,500	4
3,600	4
3,700	4
3,800	4

Volume (liters)	# of grid openings
1,250	24
1,300	23
1,400	21
1,600	19
1,800	17
2,000	15
2,200	14
2,400	13
2,600	12
2,800	11
3,000	10
3,200	9
3,400	9
3,600	8
3,800	8
4,000	8
4,200	7
4,400	7
4,600	7
4,800	6
5,000	6
5,200	6
5,400	6
5,600	5
5,800	5
6,000	5
6,200	5
6,400	5
6,600	5
6,800	4
7,000	4
7,200	4
7,400	4
7,600	4

Note minimum volumes required:
25 mm : 560 liters
37 mm : 1250 liters

Filter diameter of 25 mm – effective area of 385 sq mm
Filter diameter of 37 mm – effective area of 855 sq mm

k. At the conclusion of sampling, turn the cassette upward before stopping the flow to minimize possible particle loss. If the sampling is resumed, restart the flow before reorienting the cassette downward. Note the condition of the filter at the conclusion of sampling.

l. Double check to see that all information has been recorded on the data collection forms and that the cassette is securely closed and appropriately identified using a waterproof label. Protect cassettes in individual clean resealed polyethylene bags. Bags are to be used for storing cassette caps when they are removed for sampling purposes. Caps and plugs should only be removed or replaced using clean hands or clean disposable plastic gloves.

m. Do not change containers if portions of these filters are taken for other purposes.

6. Minimum sample number per site. A minimum of 13 samples are to be collected for each testing consisting of the following:

a. A minimum of five samples per abatement area.

b. A minimum of five samples per ambient area positioned at locations representative of the air entering the abatement site.

c. Two field blanks are to be taken by removing the cap for not more than 30 sec and replacing it at the time of sampling before sampling is initiated at the following places:

i. Near the entrance to each ambient area.

ii. At one of the ambient sites.

(Note: Do not leave the blank open during the sampling period.)

d. A sealed blank is to be carried with each sample set. This representative cassette is not to be opened in the field.

7. Abatement area sampling.

a. Conduct final clearance sampling only after the primary containment barriers have been removed; the abatement area has been thoroughly dried; and, it has passed visual inspection tests by qualified personnel. (See Reference 1 of Unit III.L.)

b. Containment barriers over windows, doors, and air passageways must remain in place until the TEM clearance sampling and analysis is completed and results meet clearance test criteria. The final plastic barrier remains in place for the sampling period.

c. Select sampling sites in the abatement area on a random basis to provide unbiased and representative samples.

d. After the area has passed a thorough visual inspection, use aggressive sampling conditions to dislodge any remaining dust.

i. Equipment used in aggressive sampling such as a leaf blower and/or fan should be properly cleaned and decontaminated before use.

ii. Air filtration units shall remain on during the air monitoring period.

iii. Prior to air monitoring, floors, ceiling and walls shall be swept with the exhaust of a minimum one (1) horsepower leaf blower.

iv. Stationary fans are placed in locations which will not interfere with air monitoring equipment. Fan air is directed toward the ceiling. One fan shall be used for each 10,000 ft super3 of worksite.

v. Monitoring of an abatement work area with high-volume pumps and the use of circulating fans will require electrical power. Electrical outlets in the abatement area may be used if available. If no such outlets are available, the equipment must be supplied with electricity by the use of extension cords and strip plug units. All electrical power supply equipment of this type must be approved Underwriter Laboratory equipment that has not been modified. All wiring must be grounded. Ground fault interrupters should be used. Extreme care must be taken to clean up any residual water and ensure that electrical equipment does not become wet while operational.

vi. Low volume pumps may be carefully wrapped in 6-mil polyethylene to insulate the pump from the air. High volume pumps cannot be sealed in this manner since the heat of the motor may melt the plastic. The pump exhausts should be kept free.

vii. If recleaning is necessary, removal of this equipment from the work area must be handled with care. It is not possible to completely decontaminate the pump motor and parts since these areas cannot be wetted. To minimize any problems in this area, all equipment such as fans and pumps should be carefully wet wiped prior to removal from the abatement area. Wrapping and sealing low volume pumps in 6-mil polyethylene will provide easier decontamination of this equipment. Use of clean water and disposable wipes should be available for this purpose.

e. Pump flow rate equal to or greater than 1 L/min or less than 10 L/min may be used for 25 mm cassettes. The larger cassette diameters may have comparably increased flow.

f. Sample a volume of air sufficient to ensure the minimum quantitation limits. (See Table I of Unit III.B.5.j.)

8. Ambient sampling.

a. Position ambient samplers at locations representative of the air entering the abatement site. If makeup air entering the abatement site is drawn

from another area of the building which is outside of the abatement area, place the pumps in the building, pumps should be placed out of doors located near the building and away from any obstructions that may influence wind patterns. If construction is in progress immediately outside the enclosure, it may be necessary to select another ambient site. Samples should be representative of any air entering the work site.

b. Locate the ambient samplers at least 3 ft apart and protect them from adverse weather conditions.

c. Sample same volume of air as samples taken inside the abatement site.

C. Sample Shipment

1. Ship bulk samples in a separate container from air samples. Bulk samples and air samples delivered to the analytical laboratory in the same container shall be rejected.

2. Select a rigid shipping container and pack the cassettes upright in a noncontaminating nonfibrous medium such as a bubble pack. The use of resealable polyethylene bags may help to prevent jostling of individual cassettes.

3. Avoid using expanded polystyrene because of its static charge potential. Also avoid using particle-based packaging materials because of possible contamination.

4. Include a shipping bill and a detailed listing of samples shipped, their descriptions and all identifying numbers or marks, sampling data, shipper's name, and contact information. For each sample set, designate which are the ambient samples, which are the abatement area samples, which are the field blanks, and which is the sealed blank if sequential analysis is to be performed.

5. Hand-carry samples to the laboratory in an upright position if possible; otherwise choose that mode of transportation least likely to jar the samples in transit.

6. Address the package to the laboratory sample coordinator by name when known and alert him or her of the package description, shipment mode, and anticipated arrival as part of the chain of custody and sample tracking procedures. This will also help the laboratory schedule timely analysis for the samples when they are received.

D. Quality Control/Quality Assurance Procedures (Data Quality Indicators)

Monitoring the environment for airborne asbestos requires the use of sensitive sampling and analysis procedures. Because the test is sensitive, it may be influenced by a variety of factors. These include the supplies used in the sampling operation, the performance of the sampling, the preparation of the grid from the filter and the actual examination of this grid in the microscope. Each of these unit operations must produce a product of defined quality if the analytical result is to be a reliable and meaningful test result. Accordingly, a series of control checks and reference standards is performed along with the sample analysis as indicators that the materials used are adequate and the operations are within acceptable limits. In this way, the quality of the data is defined, and the results are of known value. These checks and tests also provide timely and specific warning of any problems which might develop within the sampling and analysis operations. A description of these quality control/quality assurance procedures is summarized in the text below.

1. Prescreen the loaded cassette collection filters to assure that they do not contain concentrations of asbestos which may interfere with the analysis of the sample. A filter blank average of less than 18 s/mm super2 in an area of 0.057 mm super2 (nominally 10 200-mesh grid openings) and a maximum of 53 s/mm super2 for that same area for any single preparation is acceptable for this method.

2. Calibrate sampling pumps and their flow indicators over the range of their intended use with a recognized standard. Assemble the sampling system with a representative filter--not the filter which will be used in sampling--before and after the sampling operation.

3. Record all calibration information with the data to be used on a standard sampling form.

4. Ensure that the samples are stored in a secure and representative location.

5. Ensure that mechanical calibrations from the pump will be minimized to prevent transferral of vibration to the cassette.

6. Ensure that a continuous smooth flow of negative pressure is delivered by the pump by installing a damping chamber if necessary.

7. Open a loaded cassette momentarily at one of the indoor sampling sites when sampling is initiated. This sample will serve as an indoor field blank.

8. Open a loaded cassette momentarily at one of the outdoor sampling sites when sampling is initiated. This sample will serve as an outdoor field blank.

9. Carry a sealed blank into the field with each sample series. Do not open this cassette in the field.

10. Perform a leak check of the sampling system at each indoor and outdoor sampling site by activating the pump with the closed sampling cassette in line. Any flow indicates a leak which must be eliminated before initiating the sampling operation.

11. Ensure that the sampler is turned upright before interrupting the pump flow.

12. Check that all samples are clearly labeled and that all pertinent information has been enclosed before transfer of the samples to the laboratory.

E. Sample Receiving

1. Designate one individual as sample coordinator at the laboratory. While that individual will normally be available to receive samples, the coordinator may train and supervise others in receiving procedures for those times when he/she is not available.

2. Adhere to the following procedures to ensure both the continued chain-of- custody and the accountability of all samples passing through the laboratory:

a. Note the condition of the shipping package and data written on it upon receipt.

b. Retain all bills of lading or shipping slips to document the shipper and delivery time.

c. Examine the chain-of-custody seal, if any, and the package for its integrity.

d. If there has been a break in the seal or substantive damage to the package, the sample coordinator shall immediately notify the shipper and a responsible laboratory manager before any action is taken to unpack the shipment.

e. Packages with significant damage shall be accepted only by the responsible laboratory manager after discussions with the client.

3. Unwrap the shipment in a clean, uncluttered facility. The sample coordinator or his or her designee will record the contents, including a description of each item and all identifying numbers or marks. A Sample Receiving Form to document this information is attached for use when necessary. (See the following Figure 3.)

FIGURE 3—SAMPLE RECEIVING FORM

Date of package delivery _____ Package shipped from _____

Carrier _____ Shipping bill retained _____

*Condition of package on receipt _____

*Condition of custody seal _____

Number of samples received _____ Shipping manifest attached _____

Purchase Order No. _____ Project I.D. _____

Comments _____

No.	Description	Sampling Medium PC	Sampling Medium MCE	Sampled Volume Liters	Receiving ID #	Assigned #
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						

(Use as many additional sheets as needed.)

Comments _____

Date of acceptance into sample bank _____

Signature of chain-of-custody recipient _____

Disposition of samples _____

*Note: If the package has sustained substantial damage or the custody seal is broken, stop and contact the project manager and the shipper.

Note: The person breaking the chain-of-custody seal and itemizing the contents assumes responsibility for the shipment and signs documents accordingly.

4. Assign a laboratory number and schedule an analysis sequence.

5. Manage all chain-of-custody samples within the laboratory such that their integrity can be ensured and documented.

F. Sample Preparation

1. Personnel not affiliated with the Abatement Contractor shall be used to prepare samples and conduct TEM analysis. Wet-wipe the exterior of the cassettes to minimize contamination possibilities